

10/035350
152
86
FBS

10035350-102601

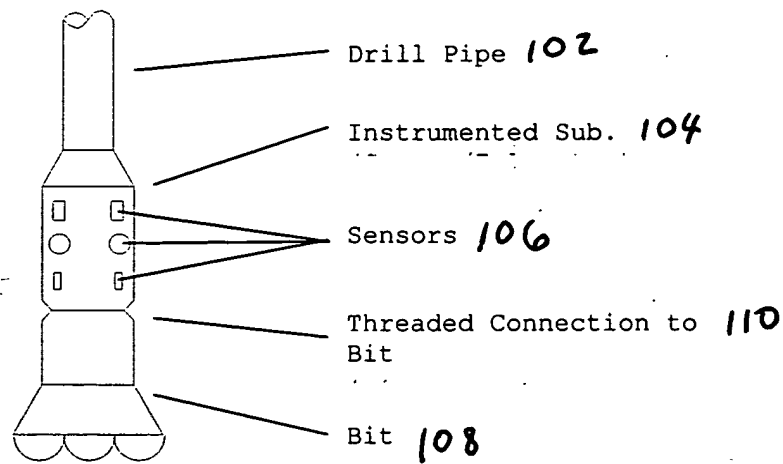


Figure 1. Sensor Placement Relative To Bit

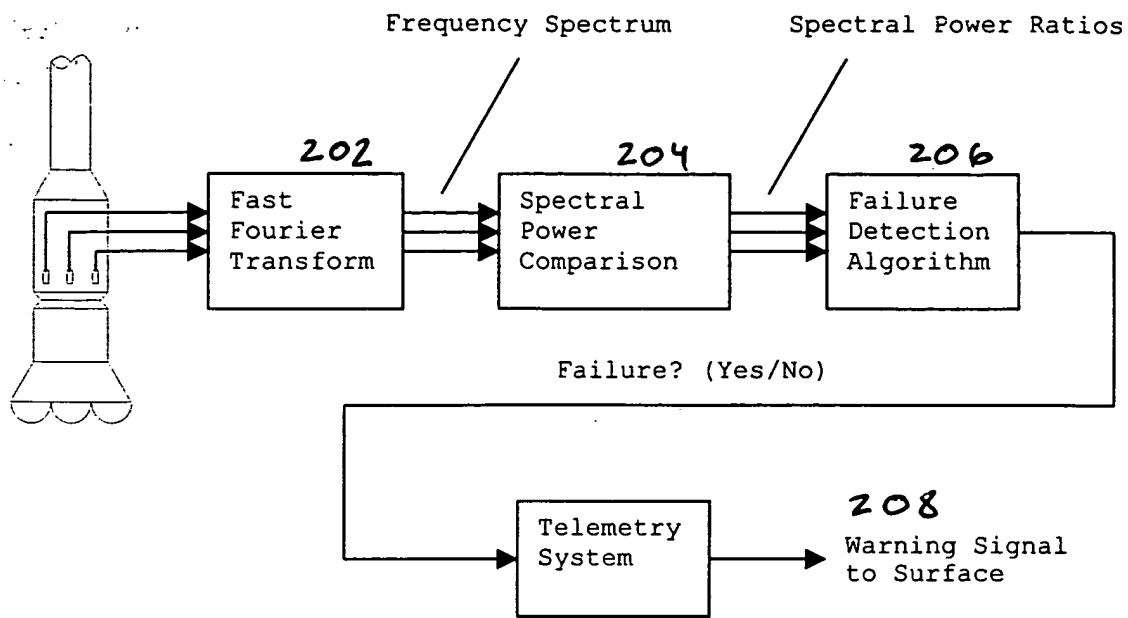


Figure 2

10035350-102601

FO920T-05E5E00T

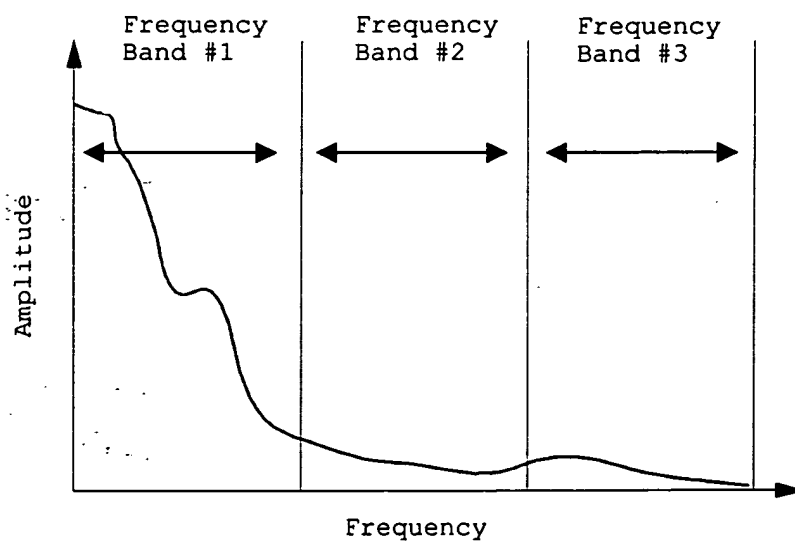


Figure 3. Frequency Band Arrangement

100350 050000Z

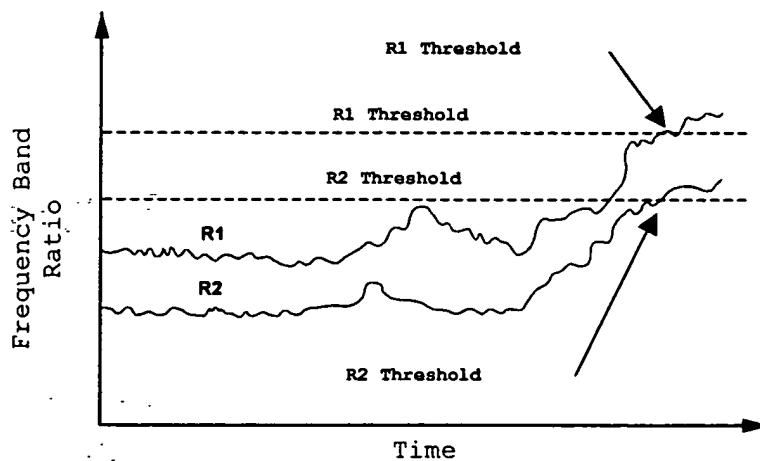


Figure 4. Threshold Failure Detection

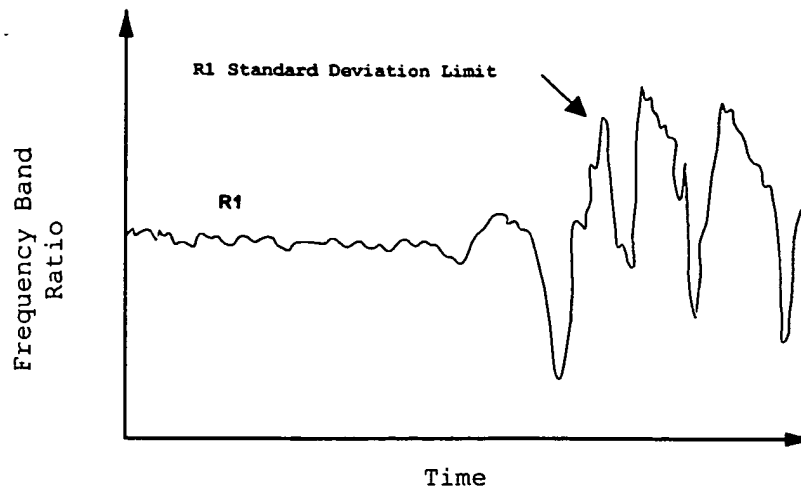


Figure 5 Statistical Failure Detection

100350-102001

1003550-102001

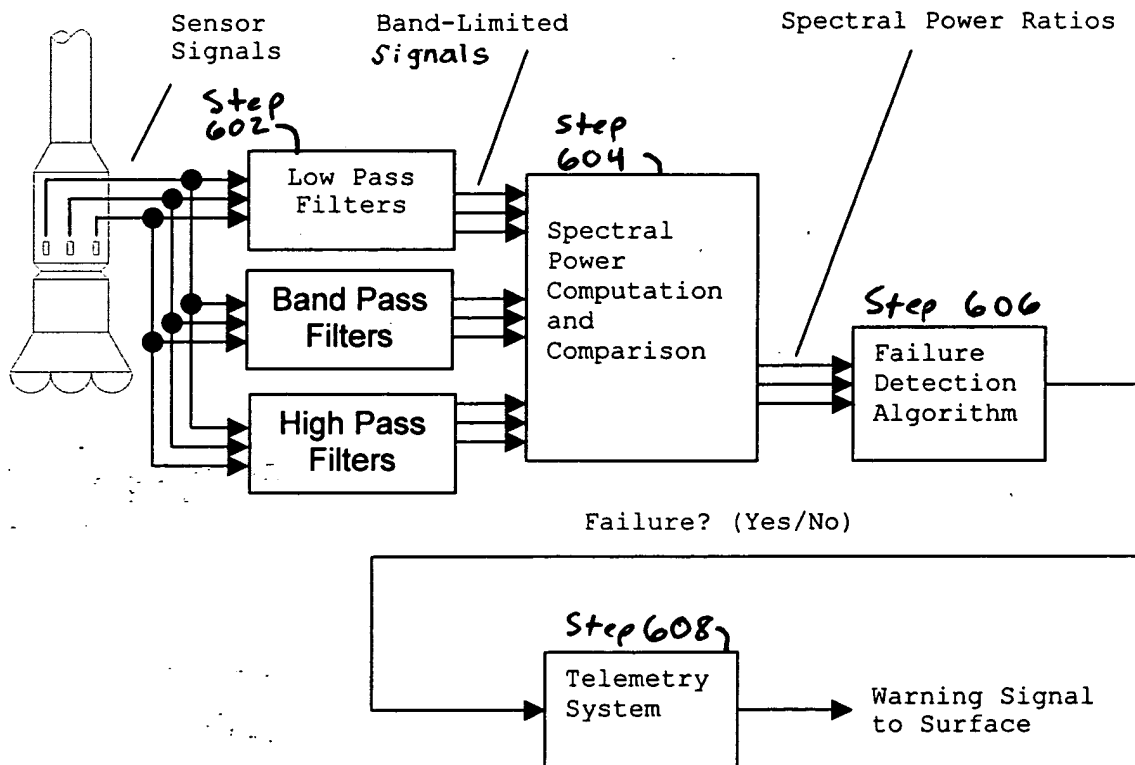


Figure 6 SPRA Method Using Analog Filters Spectral Power Separation

10055010601 050500T

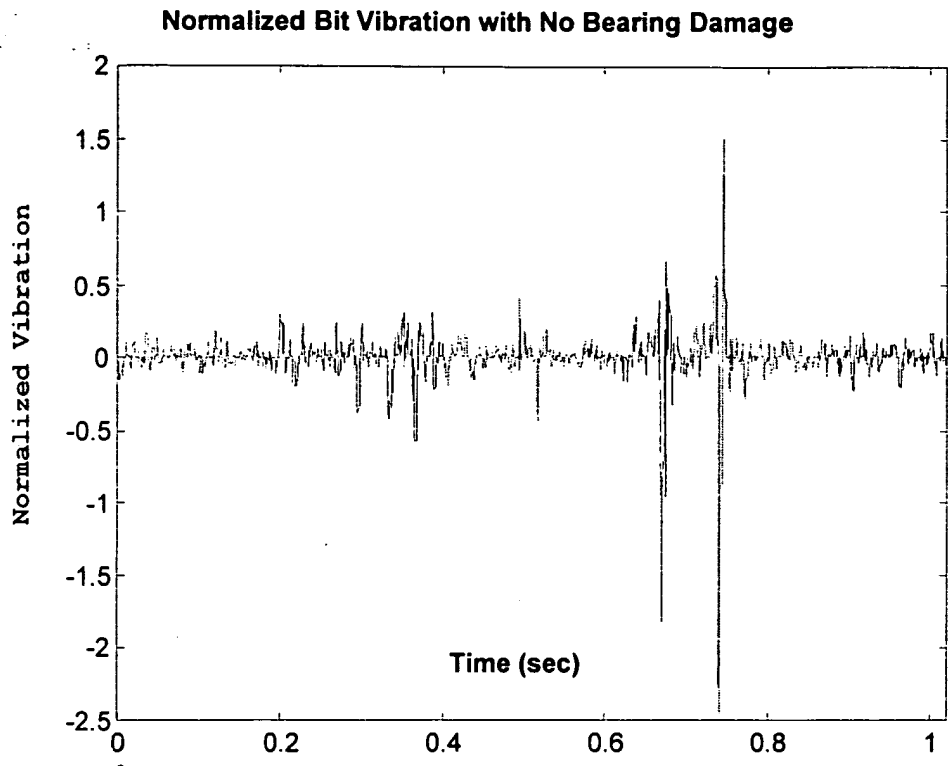


Figure 7.

Discrete FFT of Vibration Data with No Bearing Damage

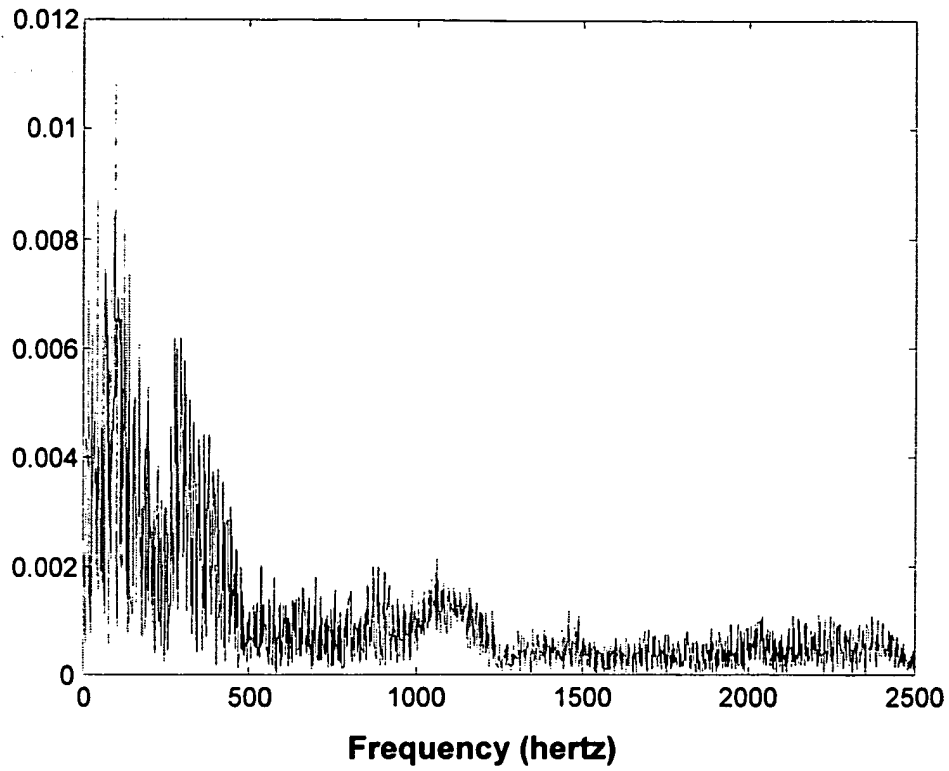


Figure 8.

10035350-102601

Spectral Power Analysis Bearing with Noise

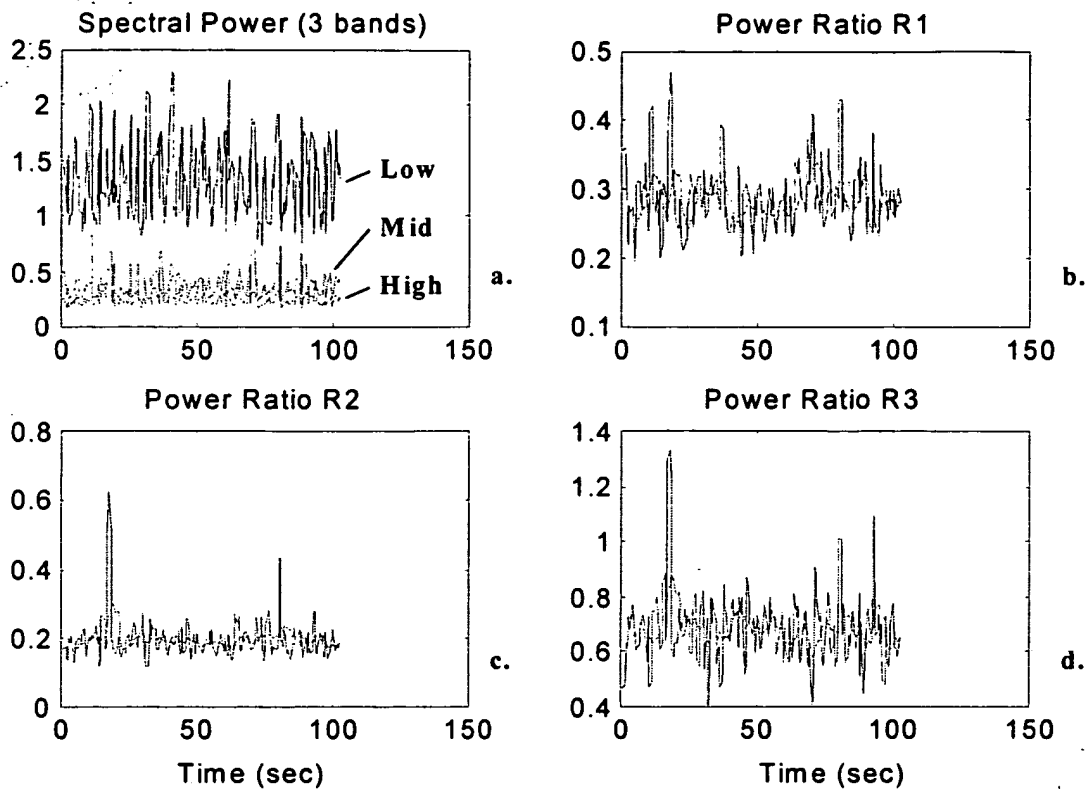


Figure 9.

10035350-102601

10035250-10501

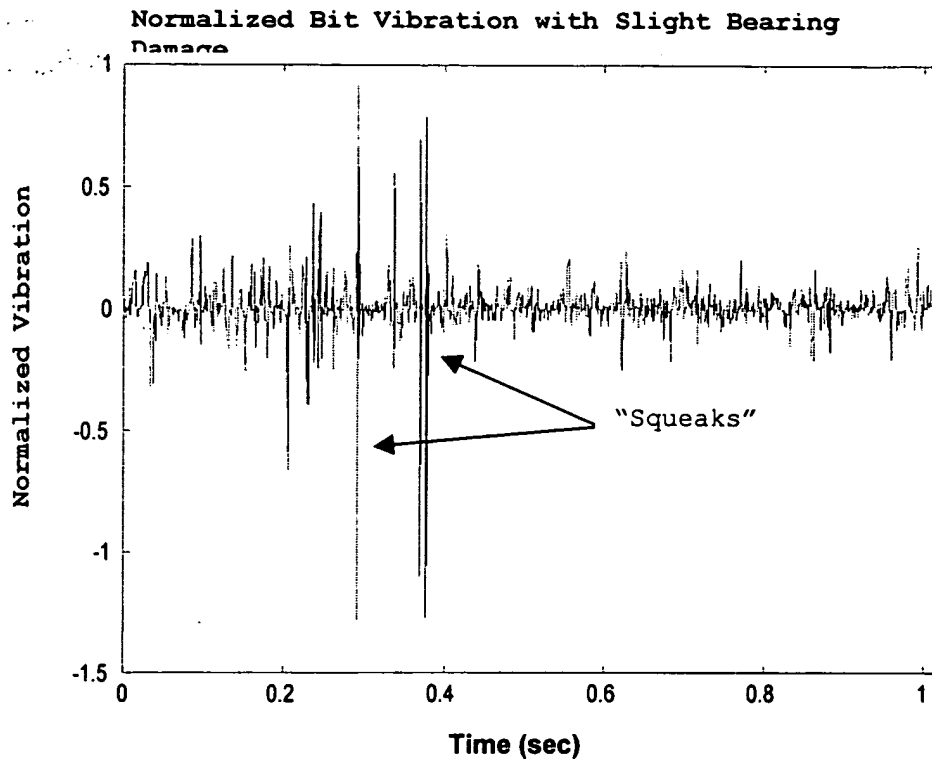


Figure 10.

Discrete FFT of Vibration Data with Initial Bearing Damage

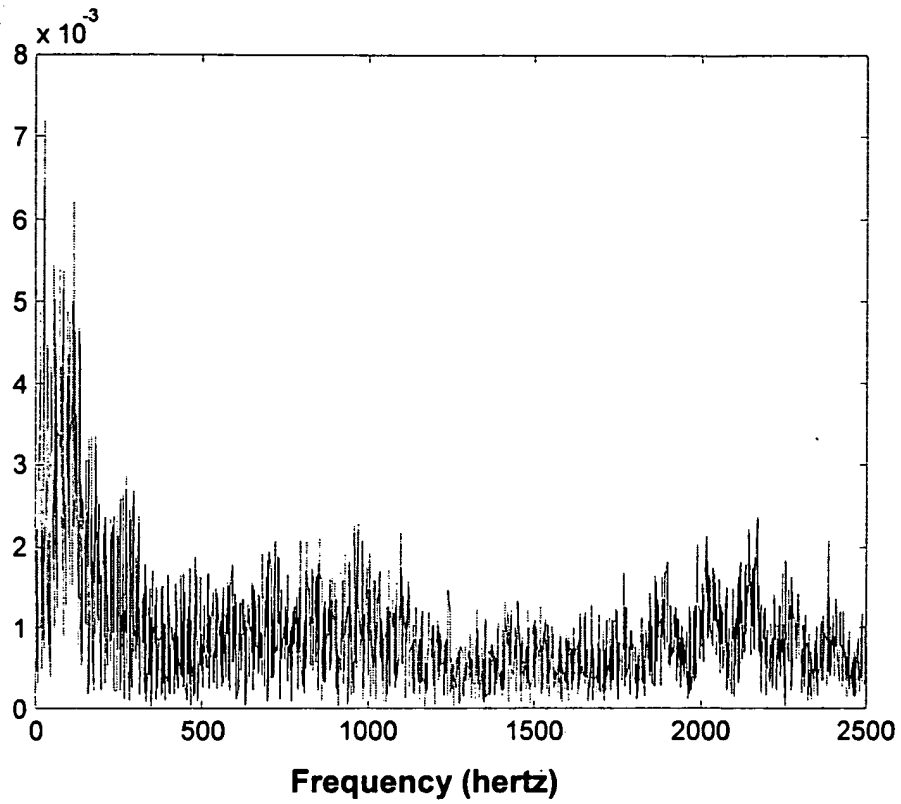


Figure 11.

10035350-10601
FO920T-05E000T

BOOKS BY L. B. E. 1



BOOKS BY L. B. E. 1



BOOKS BY L. B. E. 1

Discrete T of Vibration Data for Moderate Bearing Damage

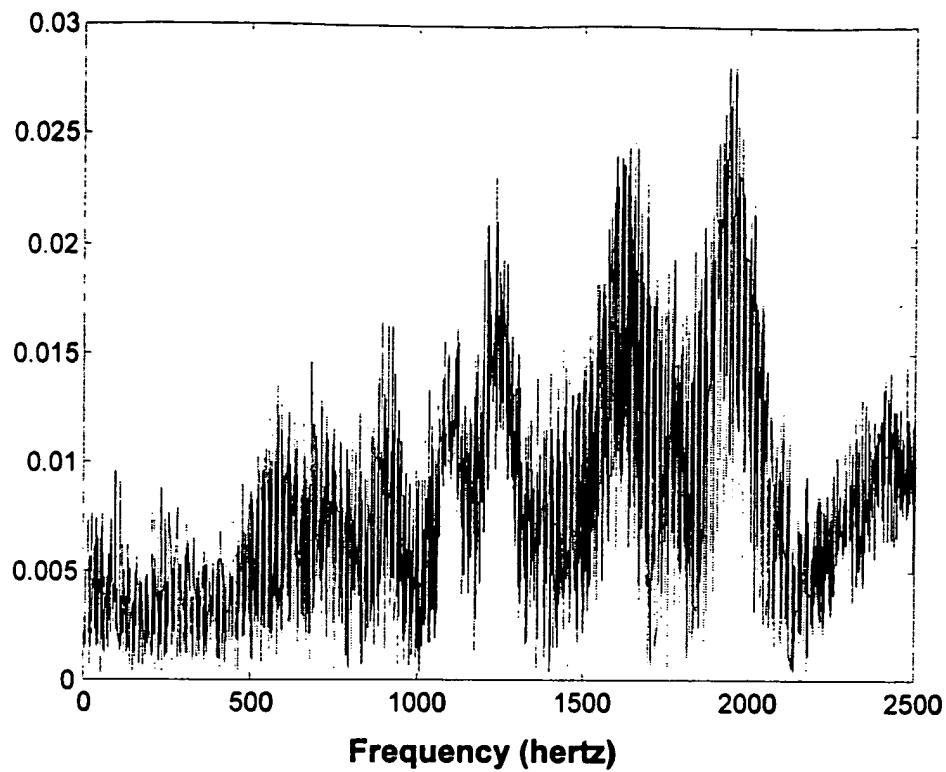


Figure 14.

100353150-102501
102201-05E5001

1003330-10601
109201-0555001

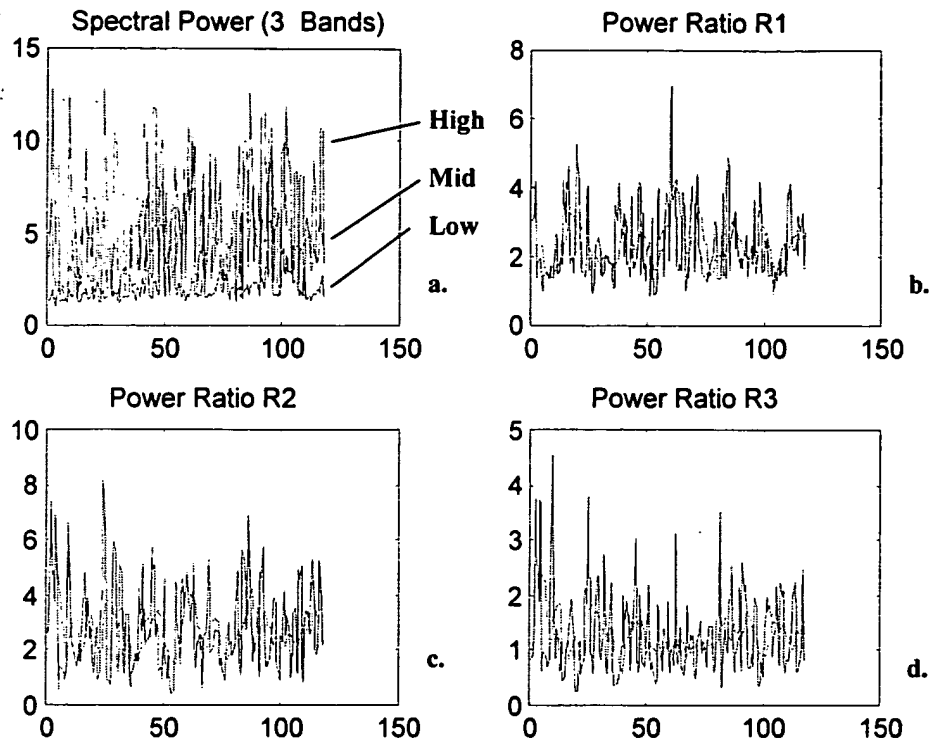


Figure 15.

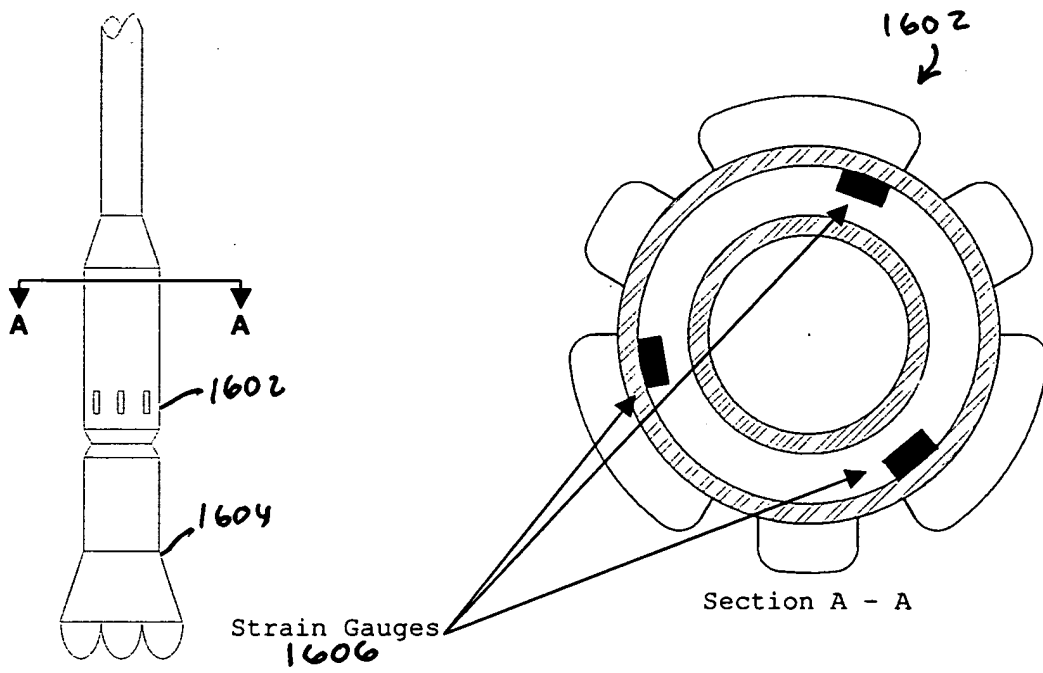


Figure 16. Strain Gauge Placement In Sensor Housing

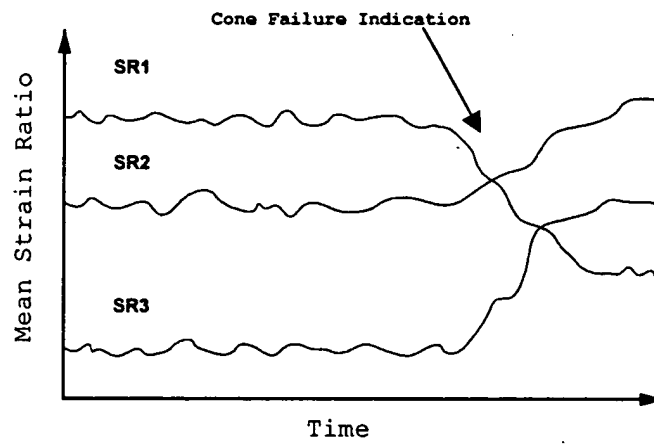


Figure 17. Failure Indication (MSRA Method)

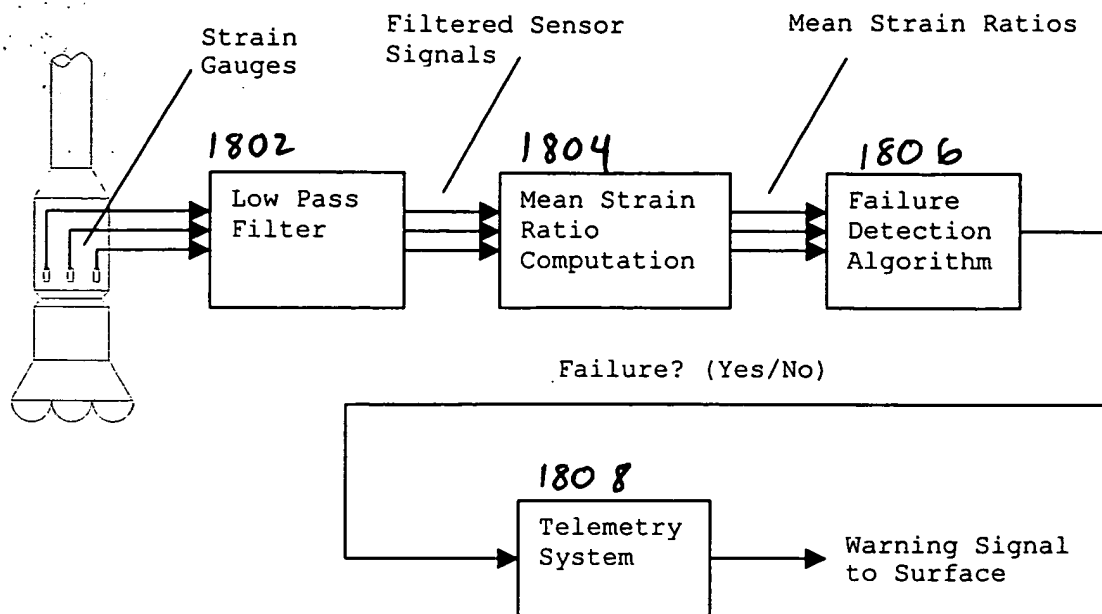


Figure 18. Schematic of MSRA Failure Detection Scheme

10035350-102601

Strain Gauge for No Bearing Damage

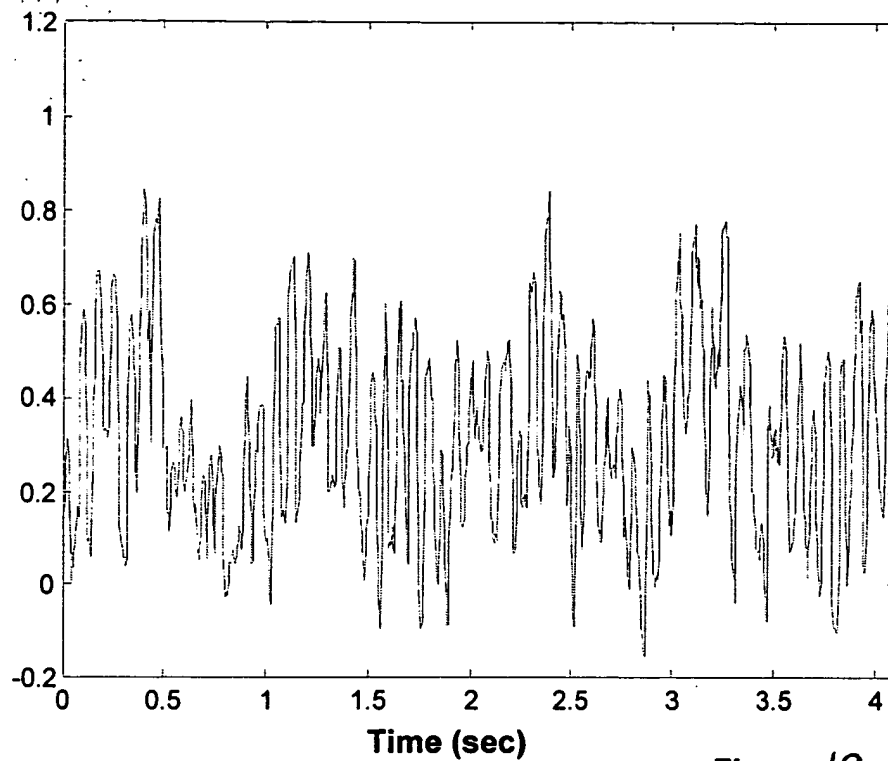


Figure 19

Discrete FFT of Strain Gauge Signal for No Bearing Damage

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10035350-102601
FO920T"05E500T

Discrete FFT of Strain Gauge Signal for No Bearing Damage

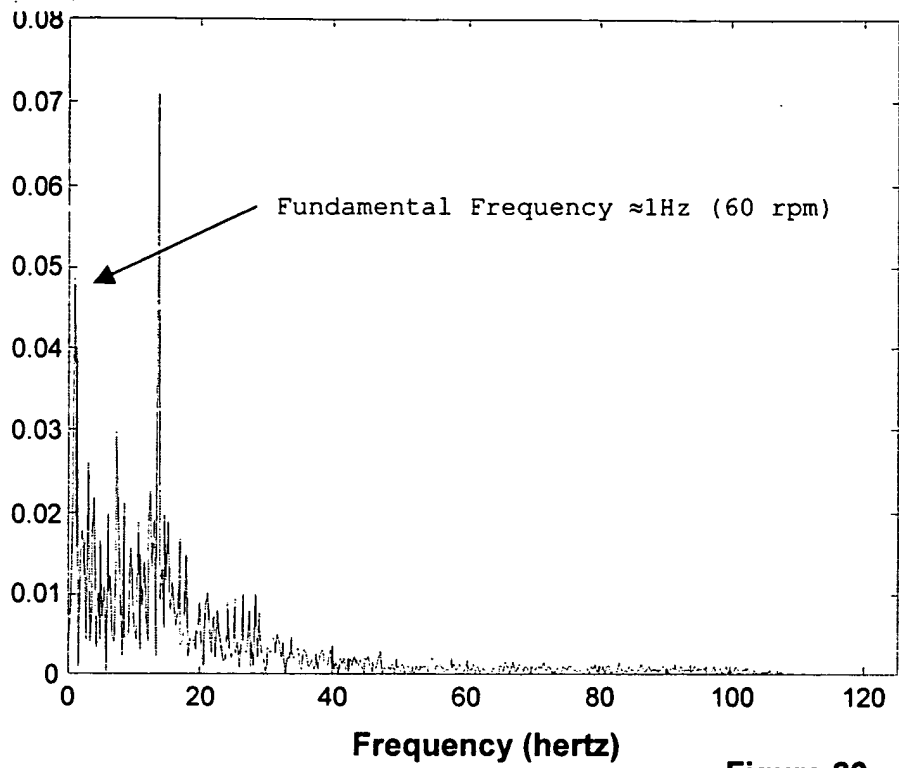


Figure 20.

Mean Strain Analysis for Bearing with No Damage

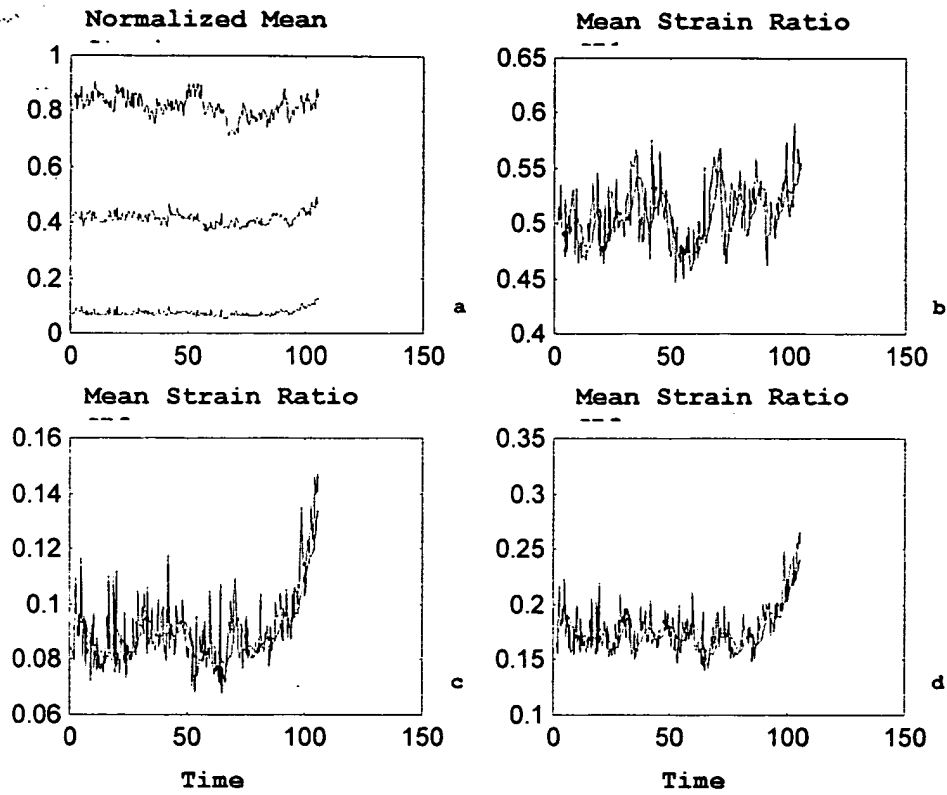


Figure 21.

109201" 092500F

Strain Gauge Signal when Bearing Lightly Damaged

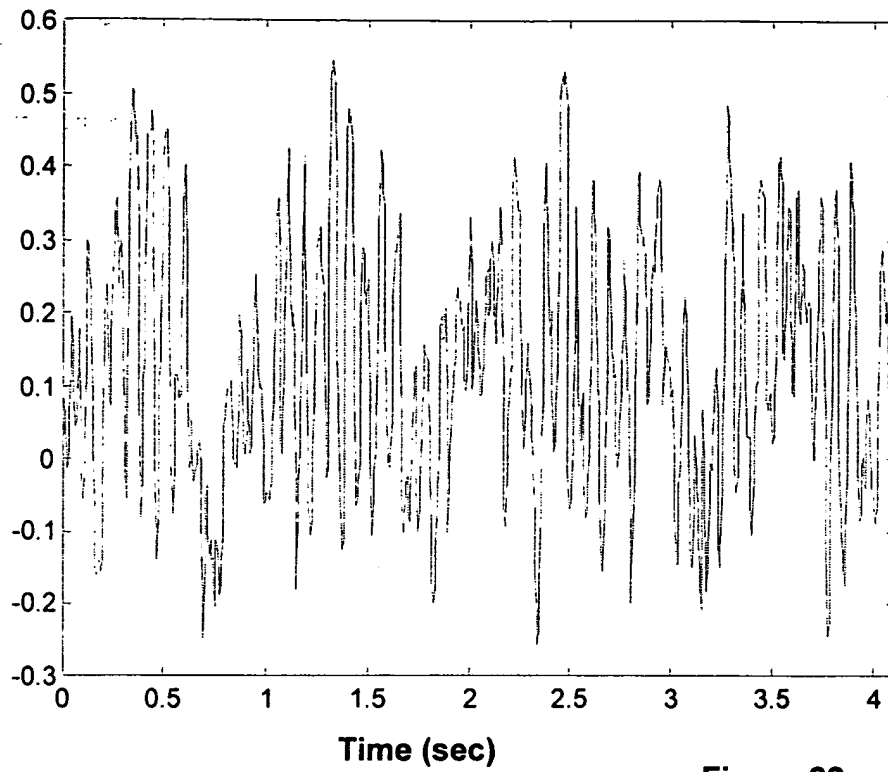


Figure 22.

10036350-10601
109201-0555001

Discrete FFT of Strain Gauge Signal for Light Bearing Damage

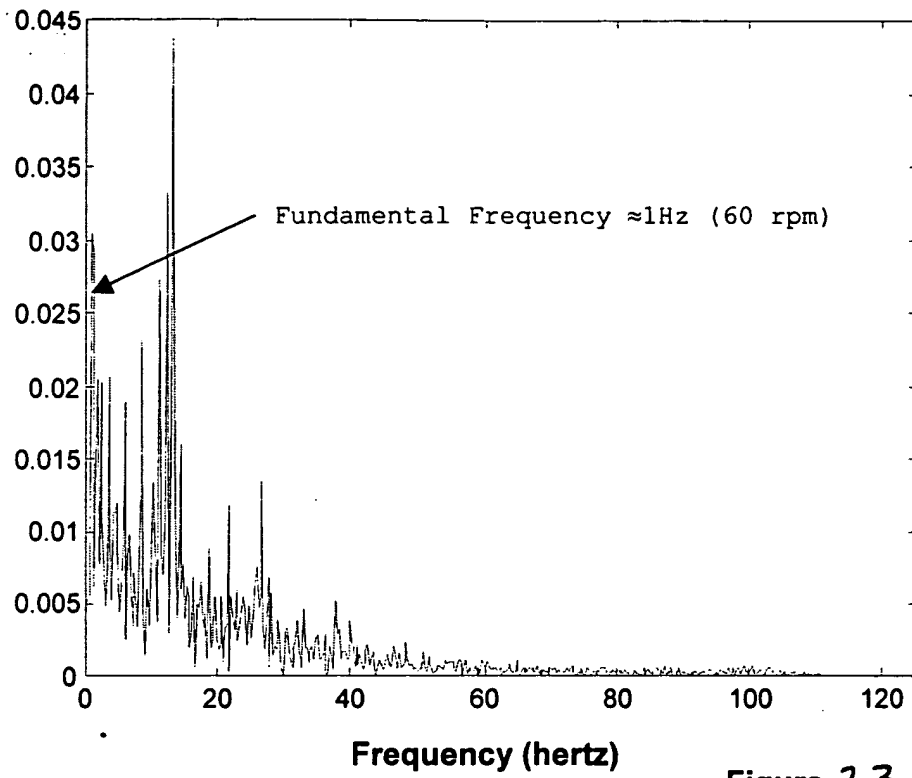


Figure 23

10035350-102601
109201-0555004

Mean Strain Analysis for Bearing with Line Damage

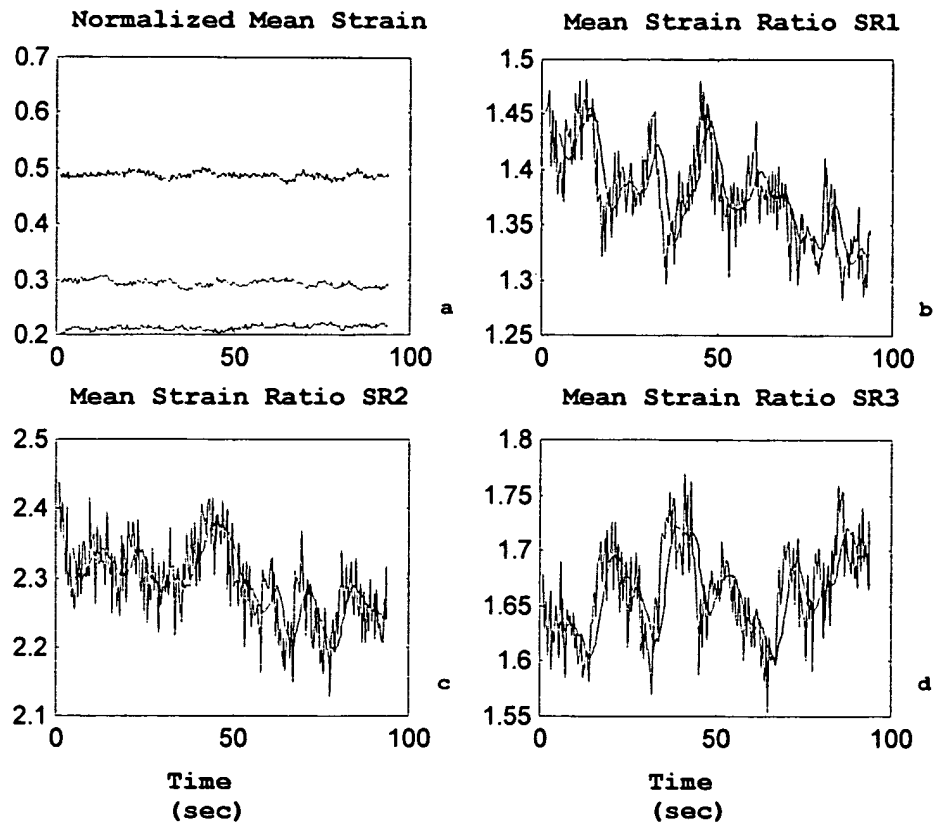


Figure 24

1003550-10601
109207-05E0007

Strain Gauge Signal when Bearing Moderately Damaged

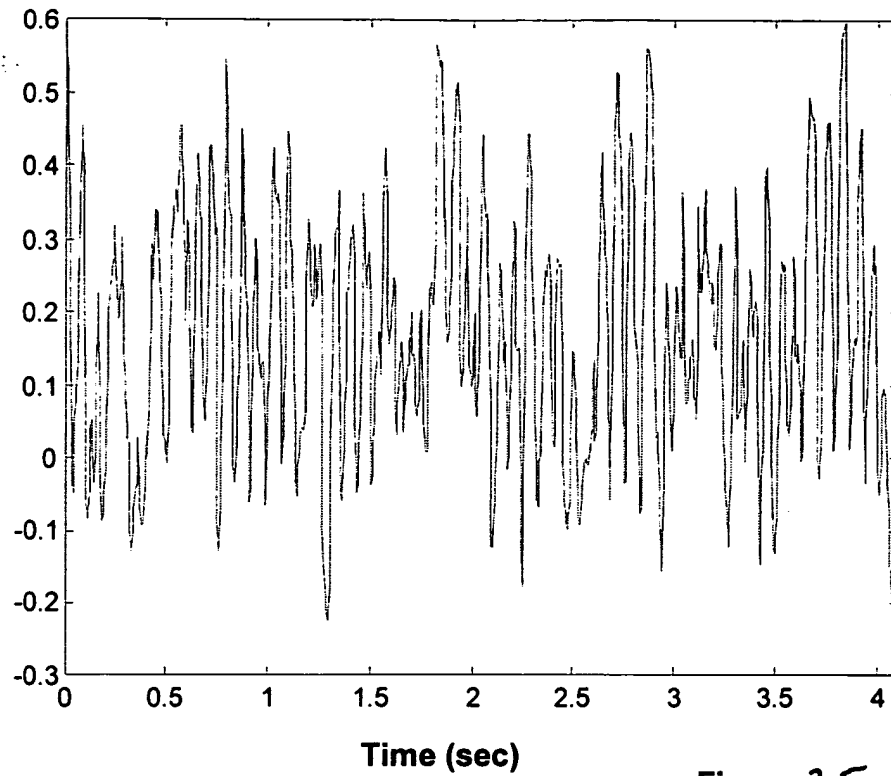


Figure 25

Discrete FFT of Strain Gauge Signal for Moderate Bearing Damage

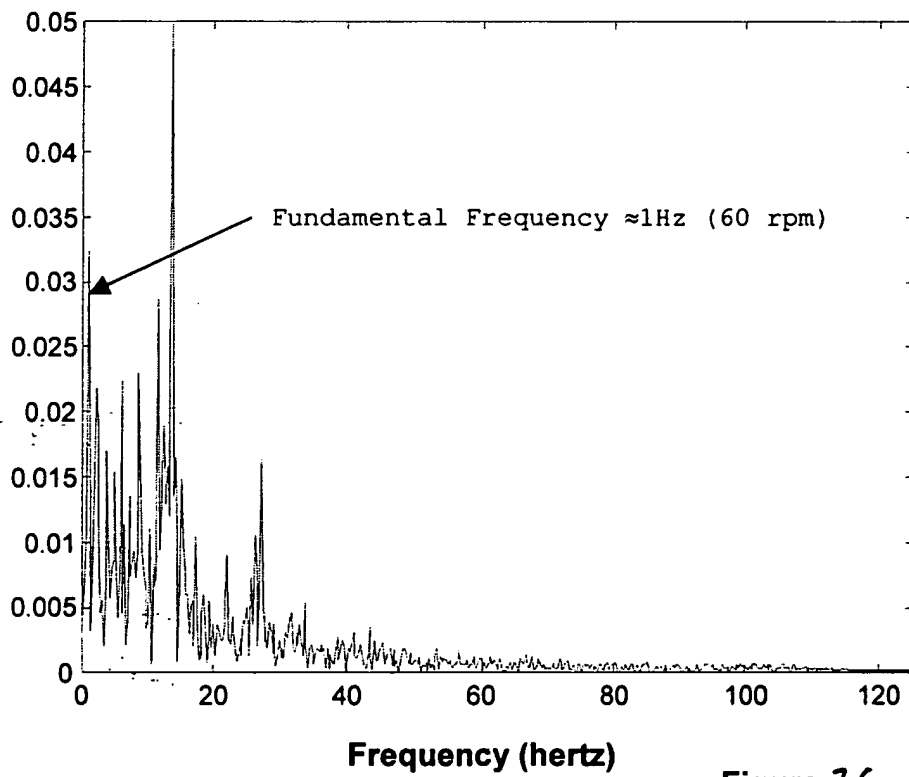


Figure 26

10035350-109201-05E5E001

Mean Strain Analysis for Bearing with Moderate Damage

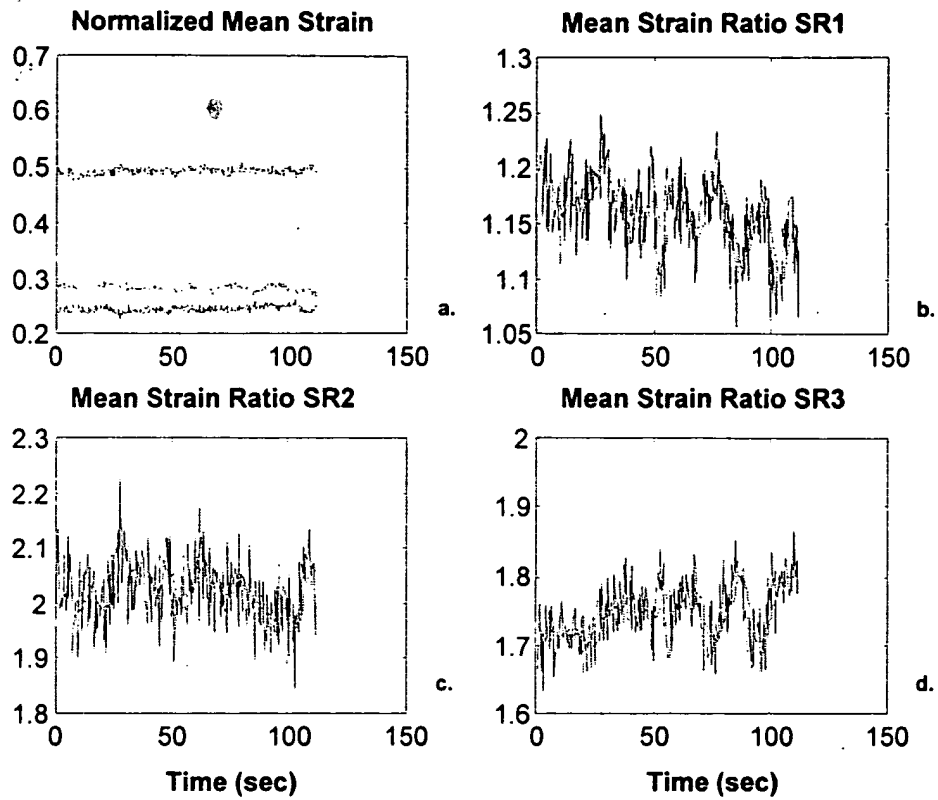


Figure 2.7

Strain Gauge Signal with Bearing In Early Failure

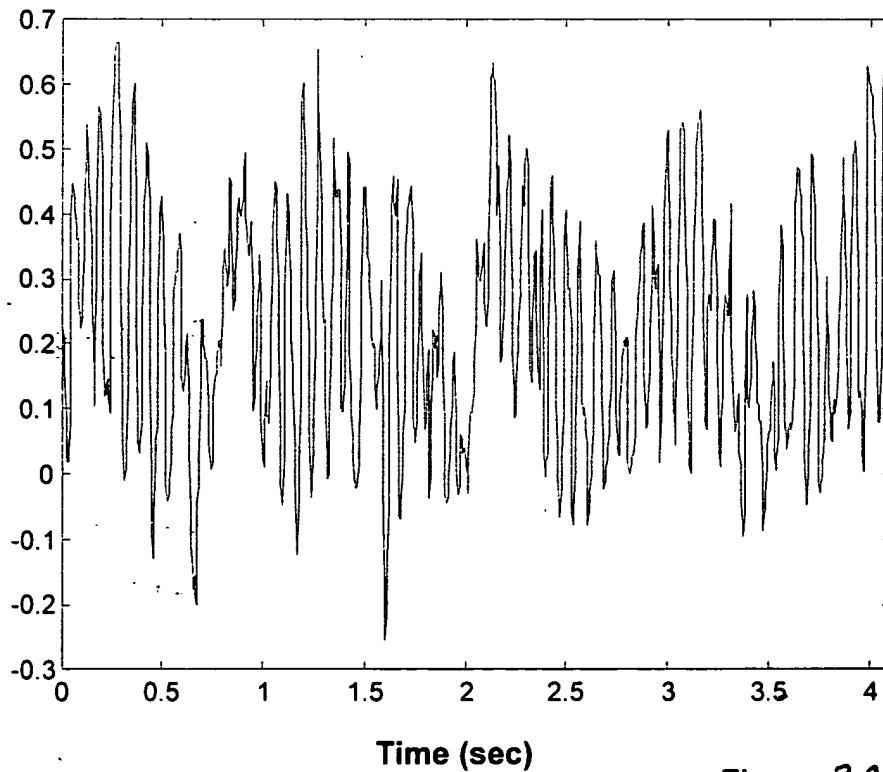


Figure 2.8

1003350 "102601

Discrete FT of Strain Gauge Signal for Bearing In Early Failure

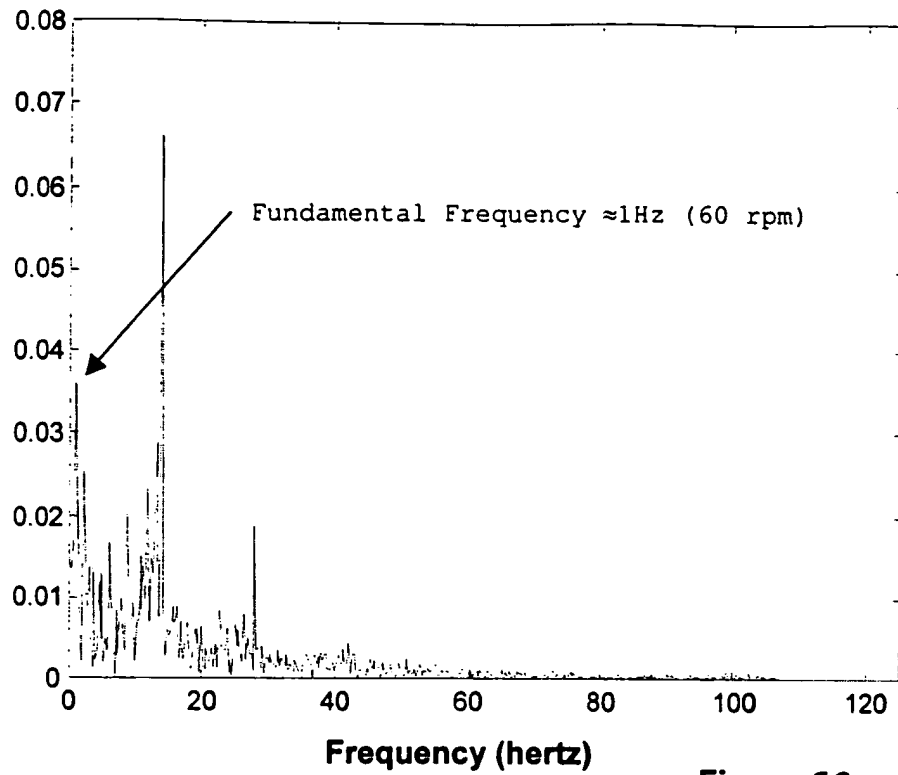


Figure 29

1003350.102601
109207.0552007

Mean Strain Analysis for Bearing in Early Failure

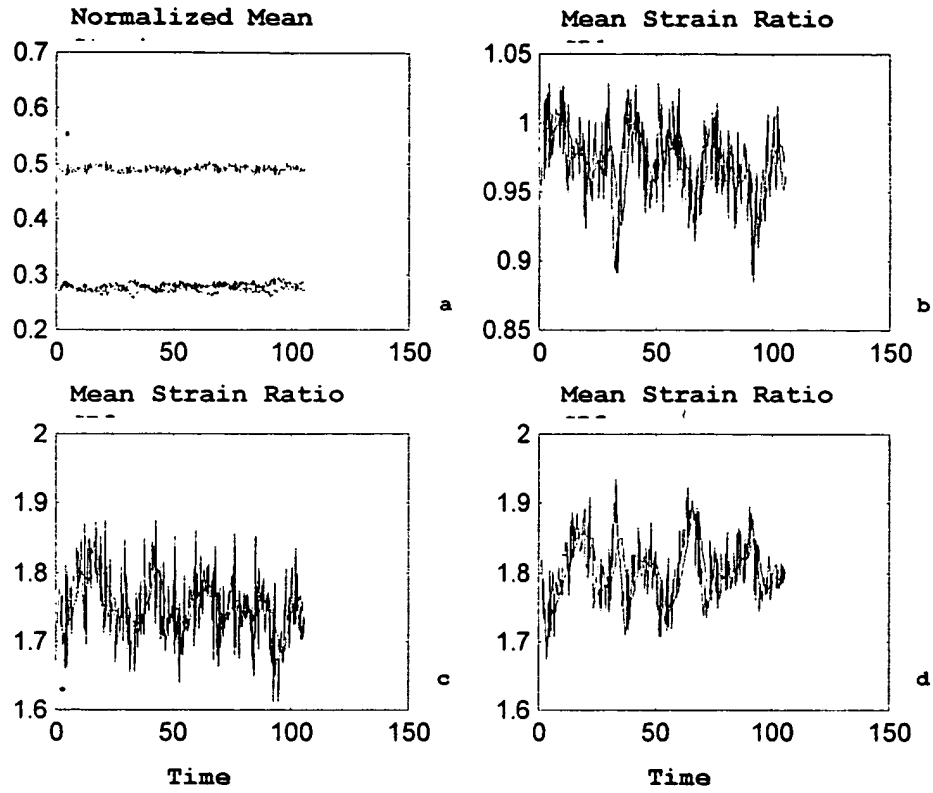


Figure 30.

10035350-102604

Mean Strain Analysis for Shifting Load Condition

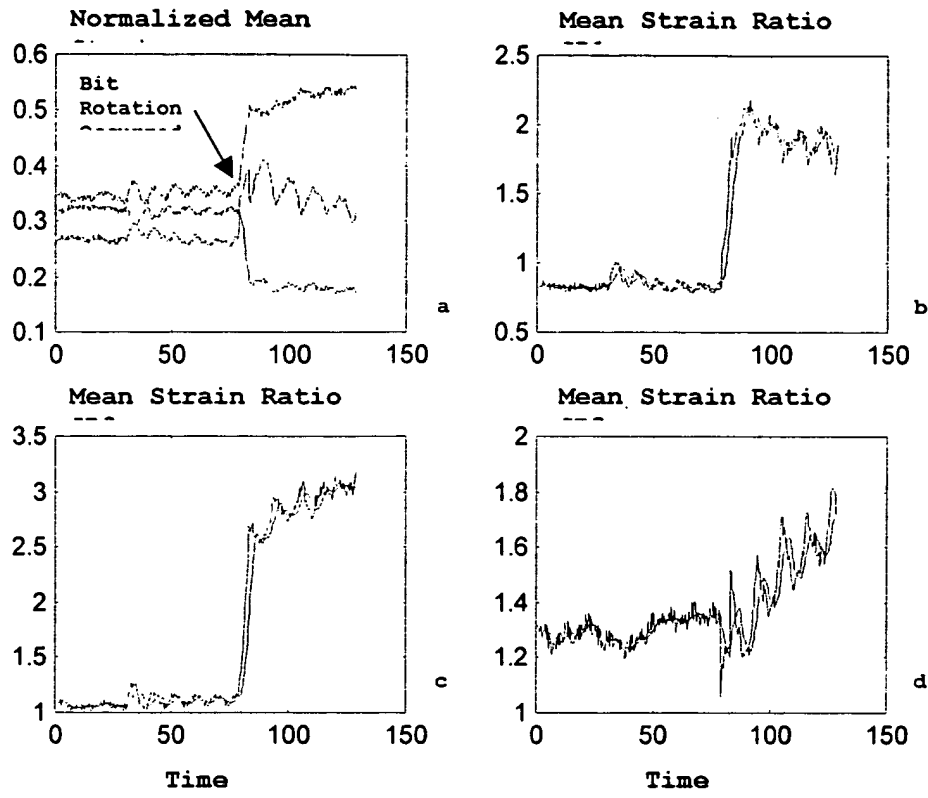


Figure 31.

1003560-10601

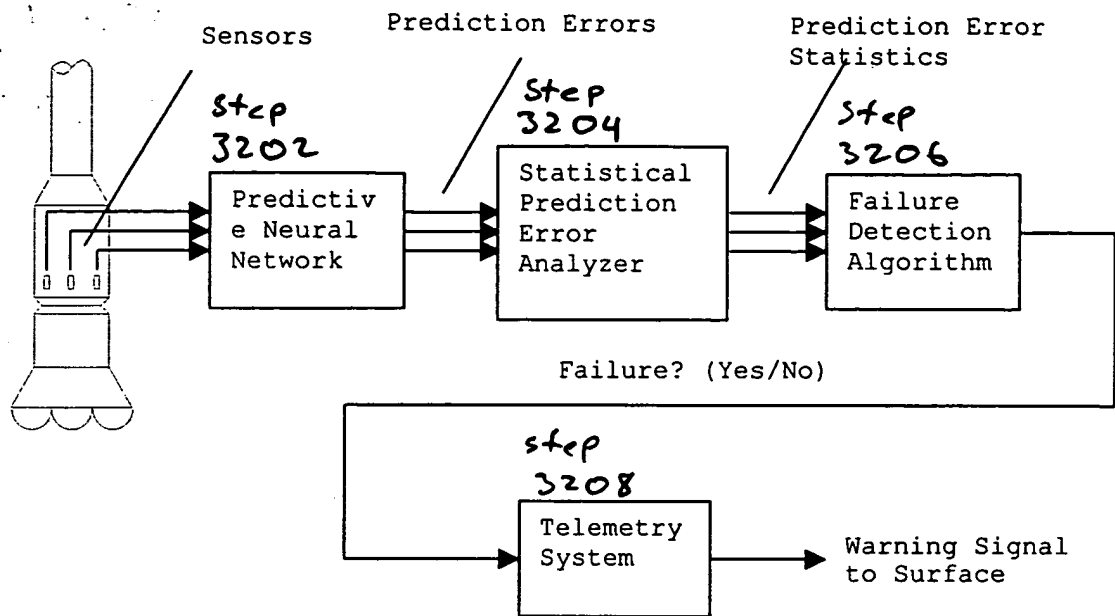


Figure 32 Schematic of ANNPA Bearing Failure Detection Scheme

10035350-102601-109201-0555001

1005501050001

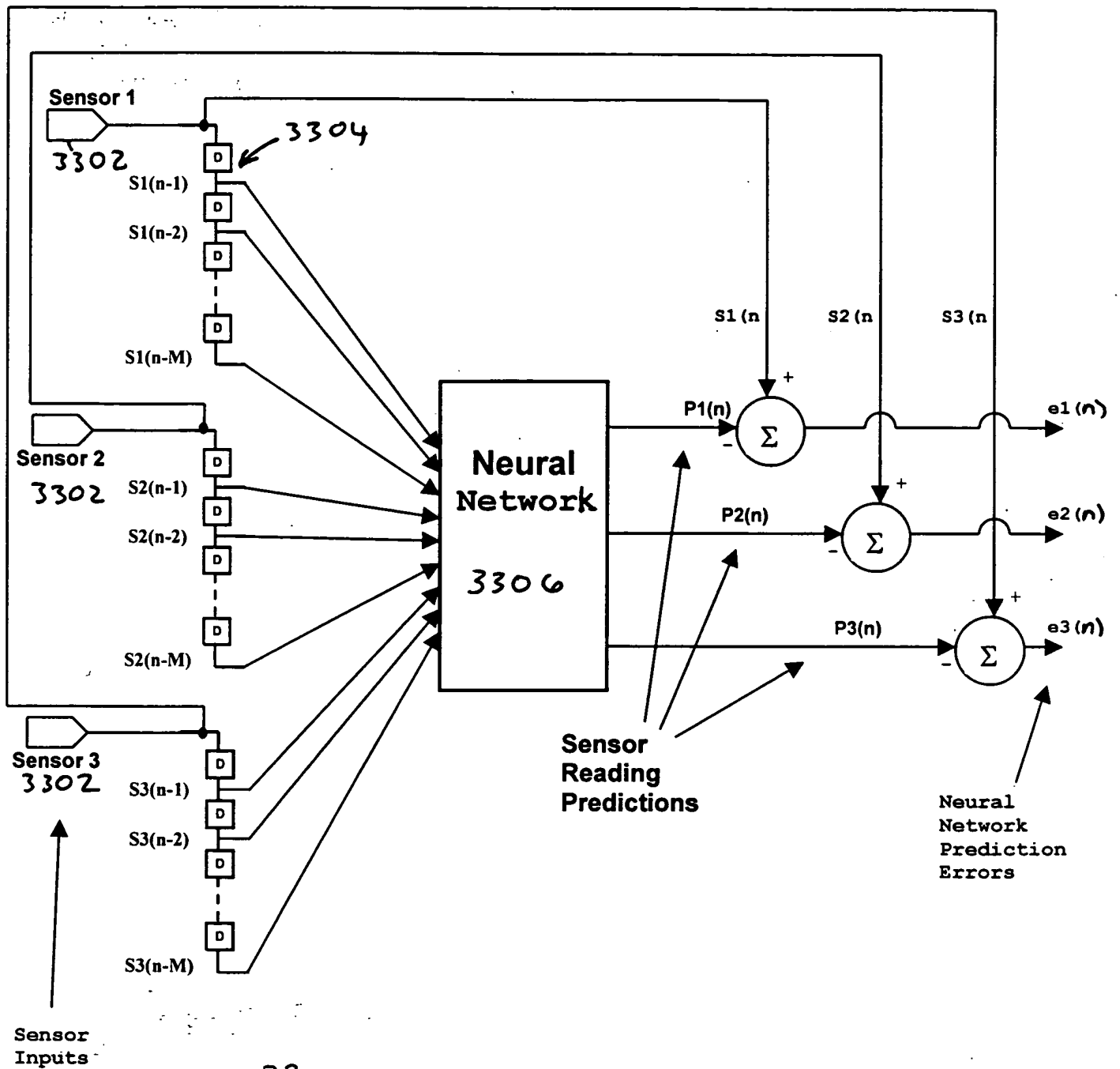


Figure 33 Adaptive Neural Network Predictor (ANNPA Method)

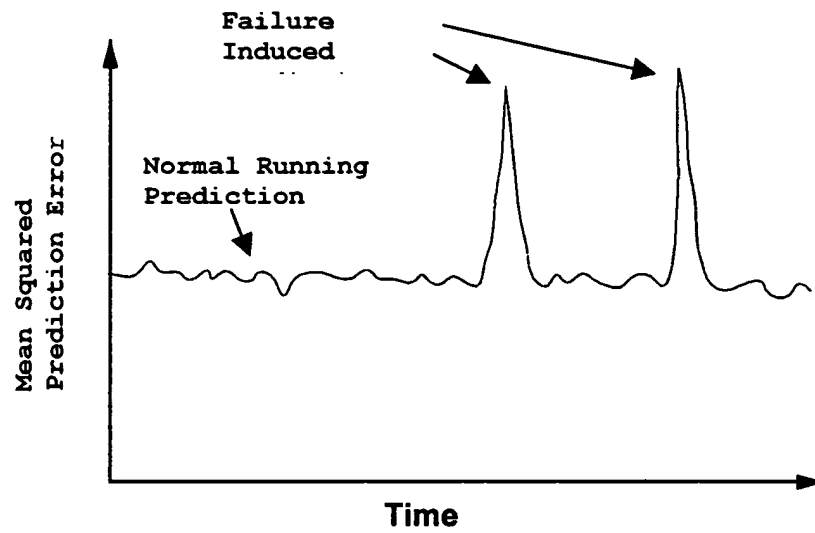


Figure 34 Failure Indications (ANNPA Method)

109201-0565001

T0920T"05E5E00T

Acceleration (No Bearing Damage)

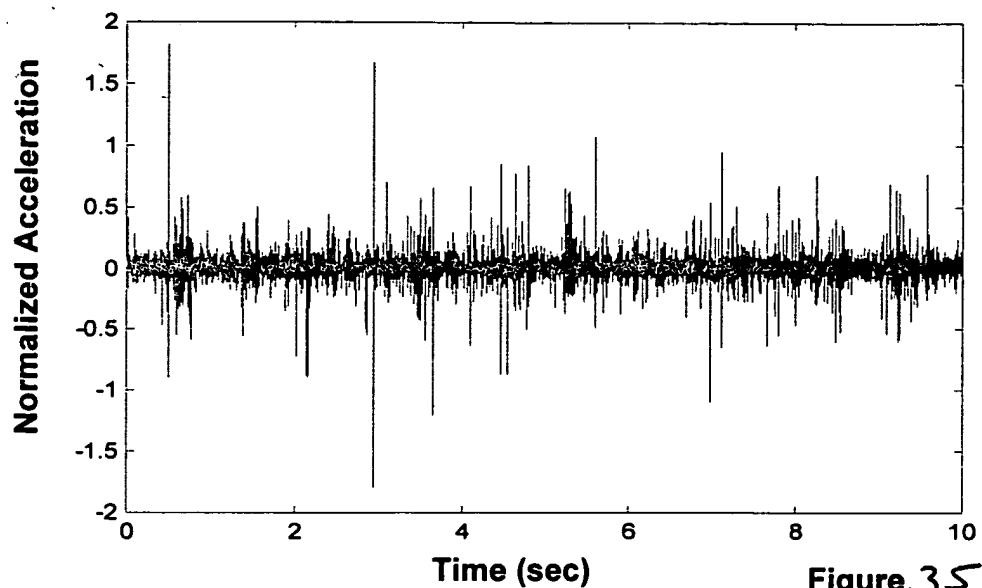


Figure 35

Acceleration Prediction Error (No Bearing Damage)

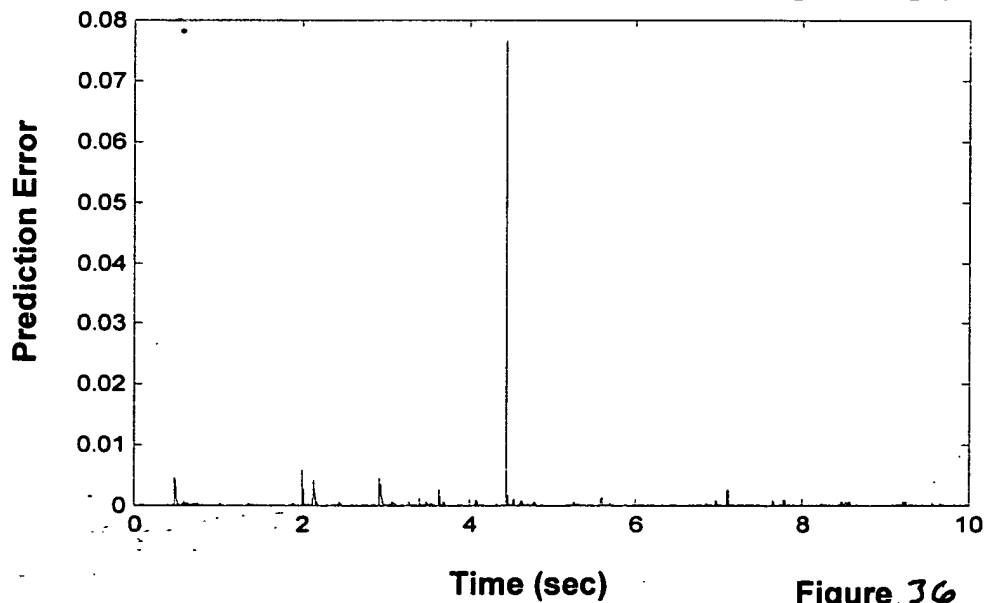


Figure 36

1005501055001

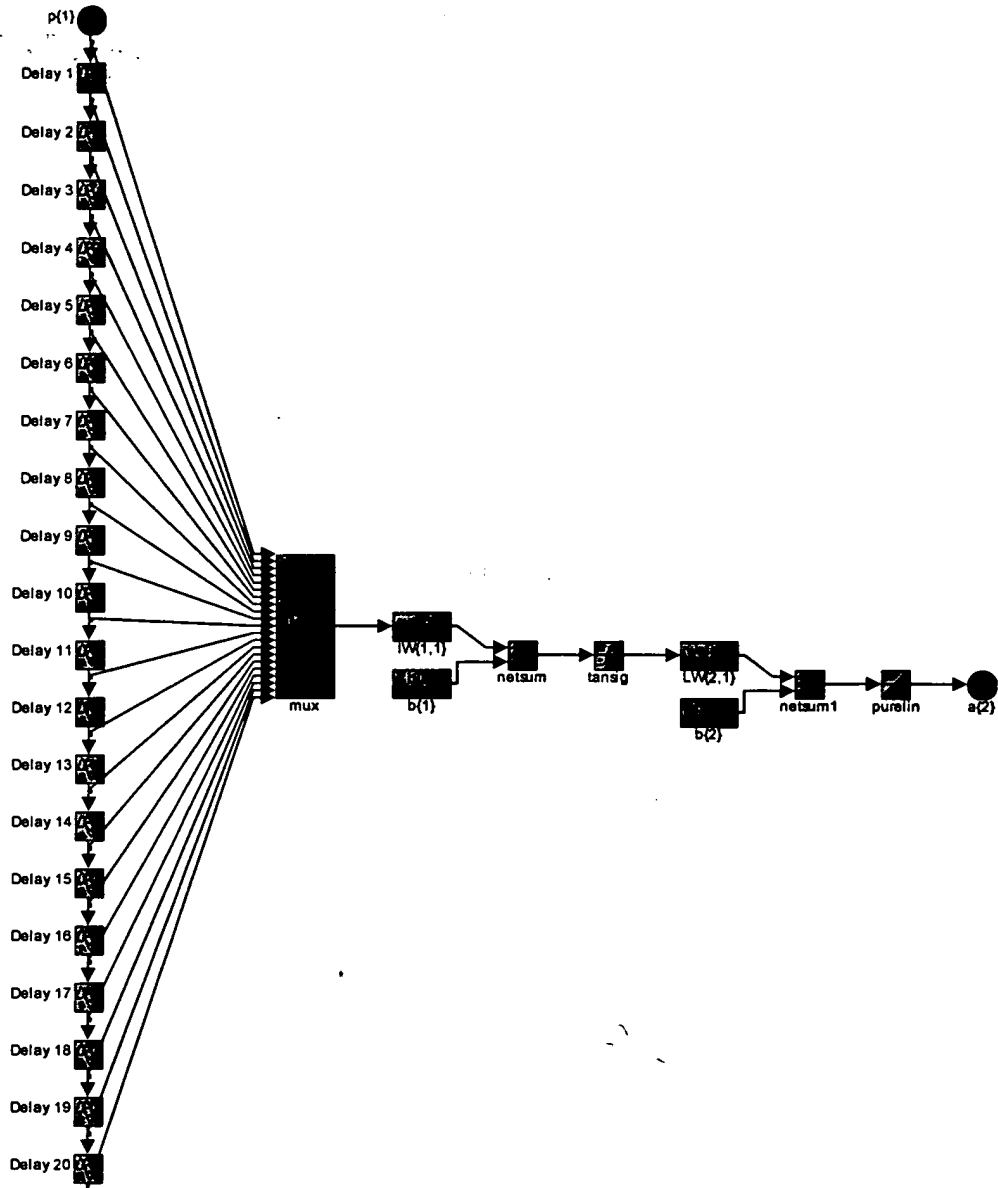
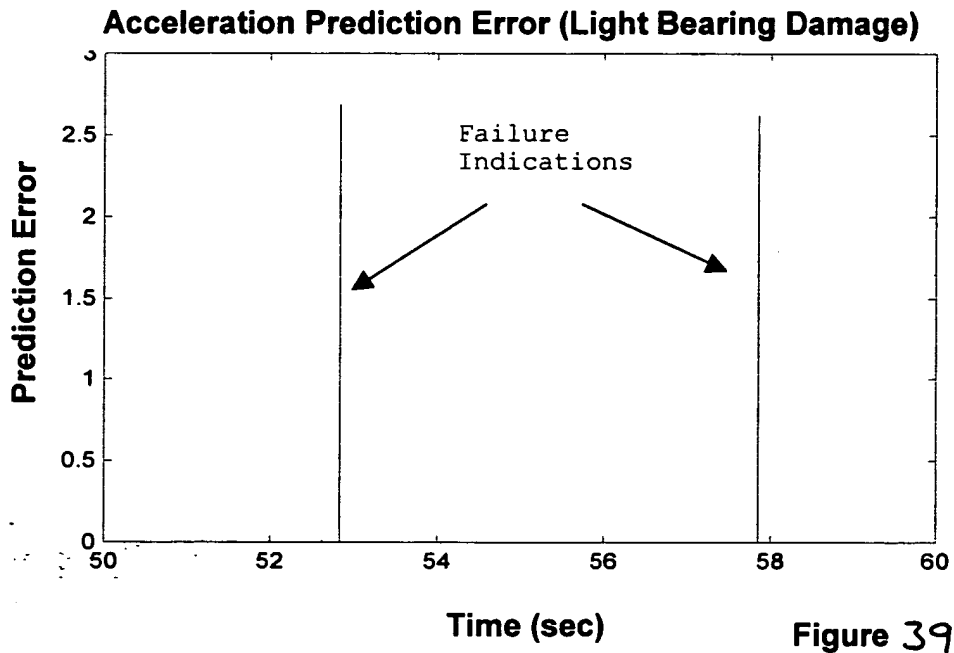
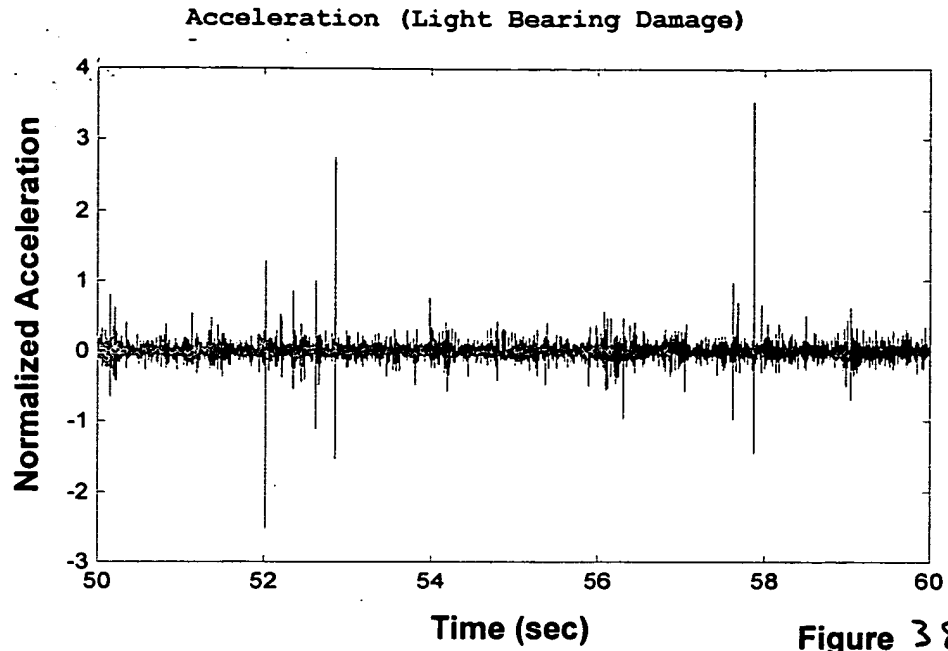


Figure 37

FO920T"05E5E00T



109201" 05E5E00T

Acceleration (Moderate Bearing Damage)

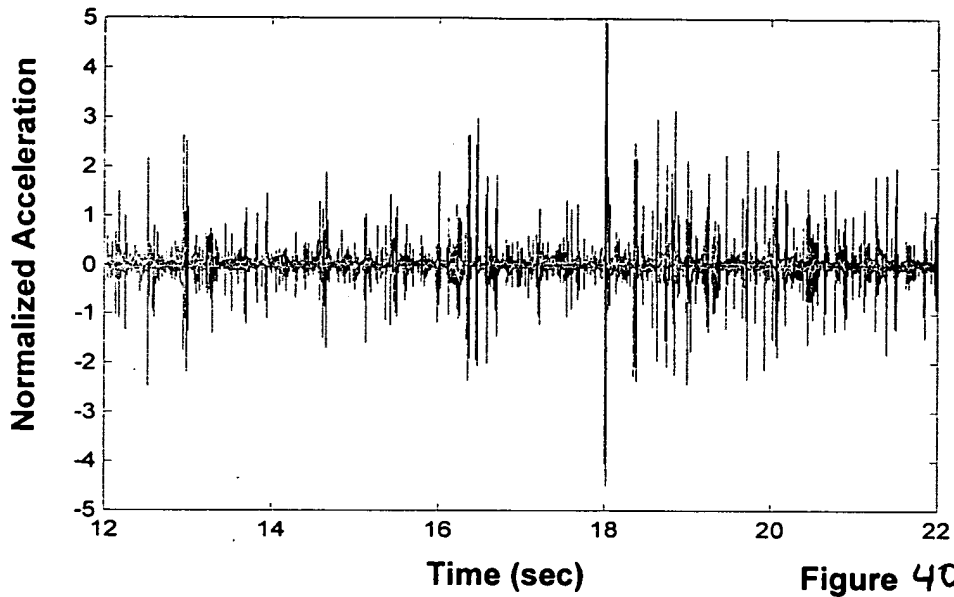


Figure 40

Acceleration Prediction Error (Moderate Bearing Damage)

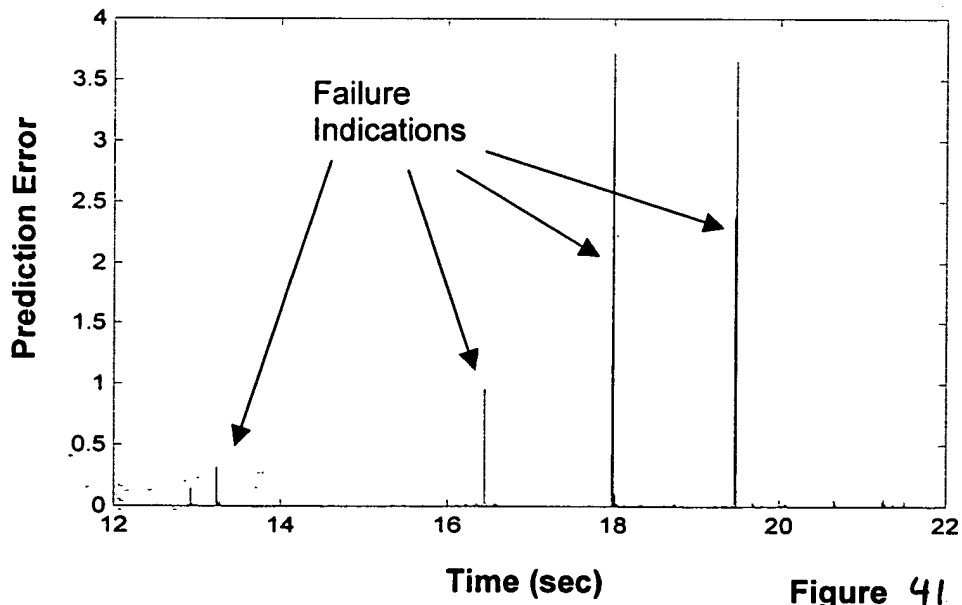


Figure 41

109201"05E5E00F

Acceleration (Heavy Bearing Damage)

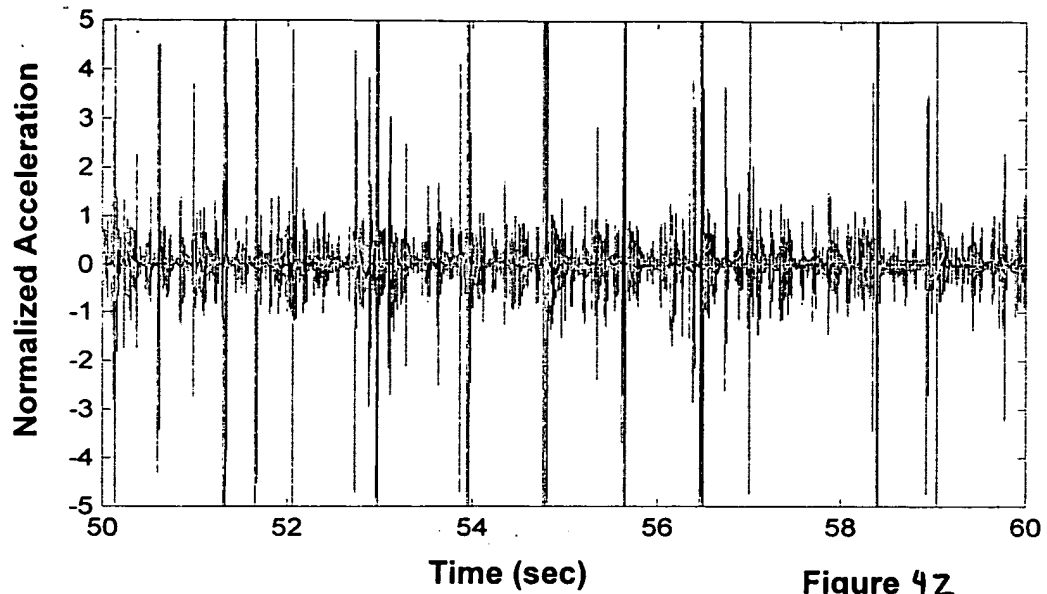


Figure 42

Acceleration Prediction Error (Heavy Bearing Damage)

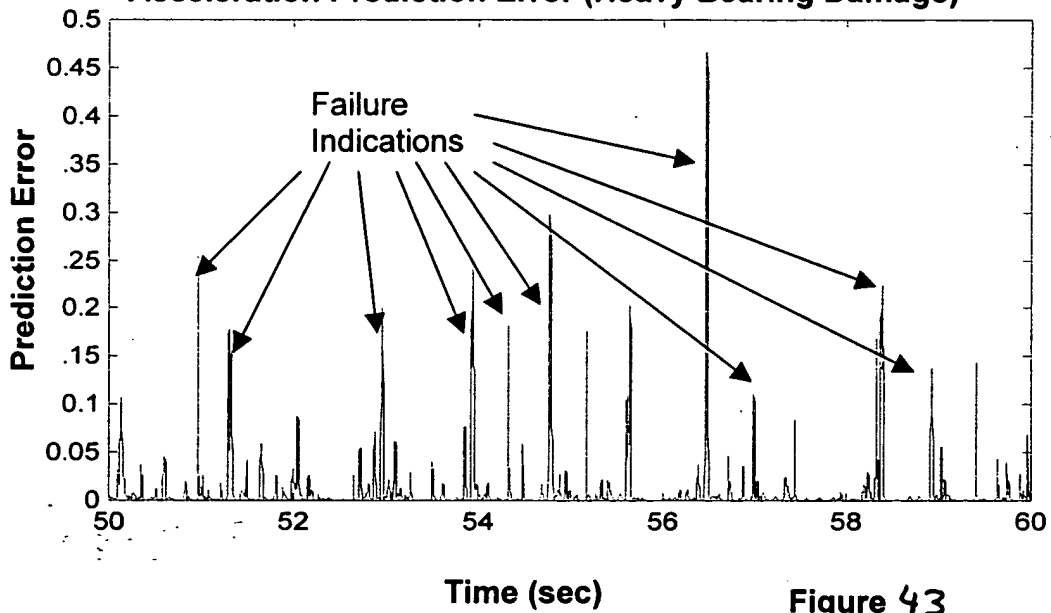


Figure 43

10035350-102601

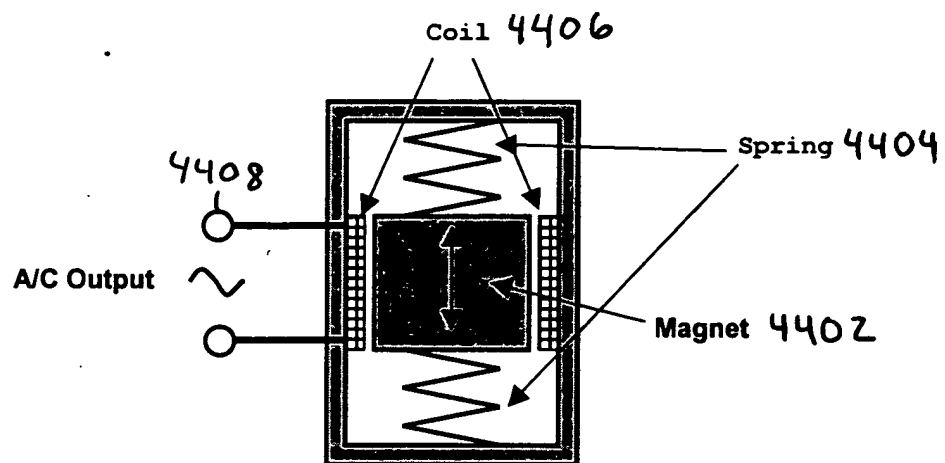


Figure 44 Diagram of Voice Coil Power Generator

100550-102501
T0920T"05E5E00T

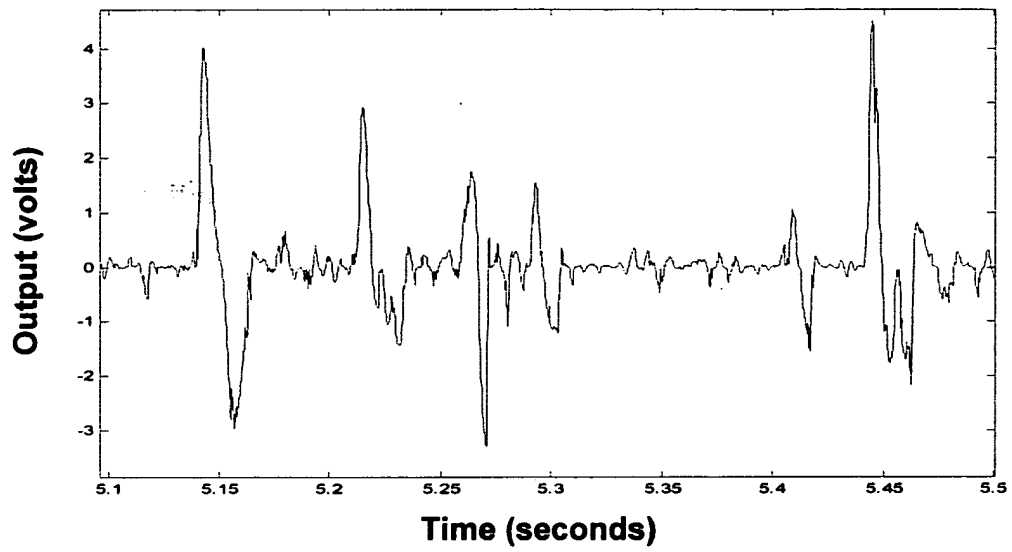


Figure 45 Scaled-Down Prototype Power Generator Output (1000 Ω Load)

TOP SECRET

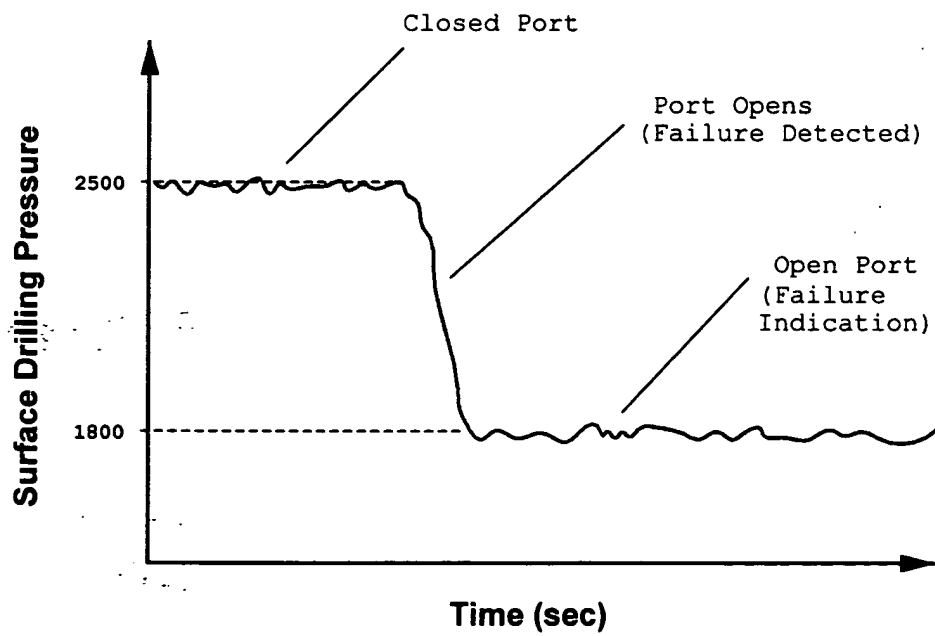


Figure 46 Open Port Failure Indication

10035350-102601

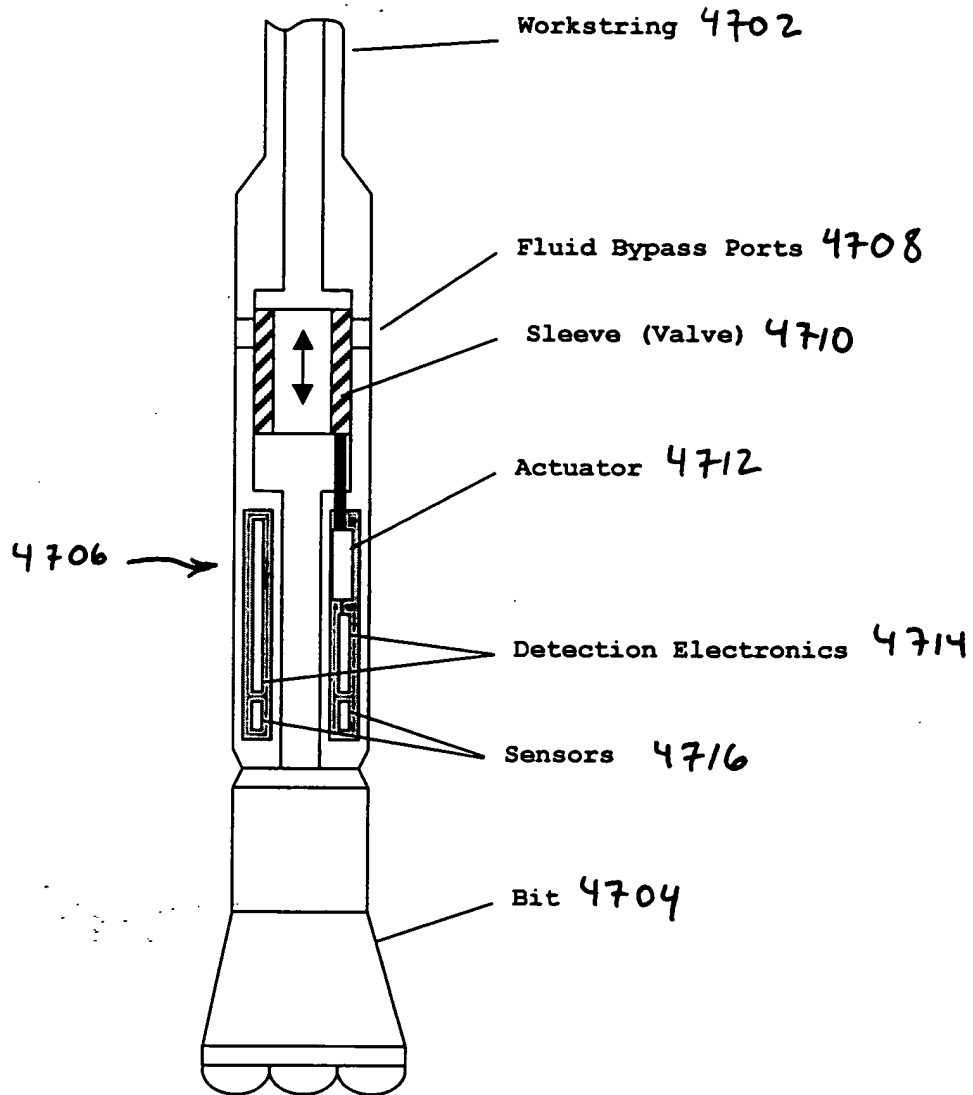


Figure 47 Downhole Tool Schematic

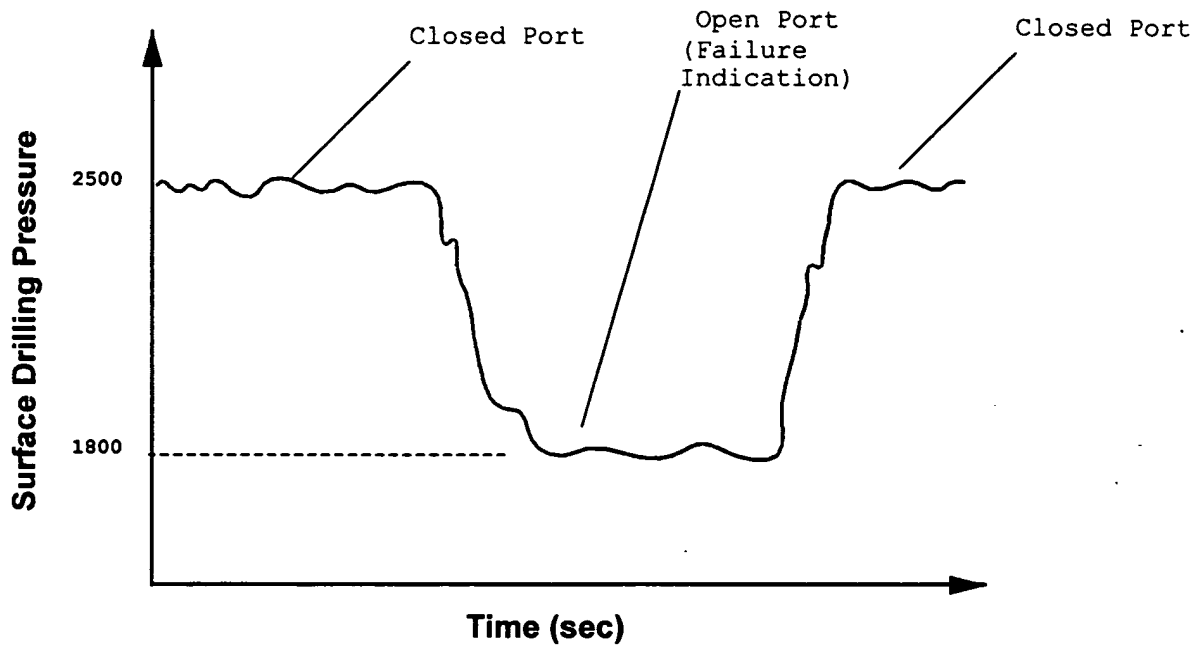


Figure 48 Open-Close Signaling Operation

FOUO 05500T

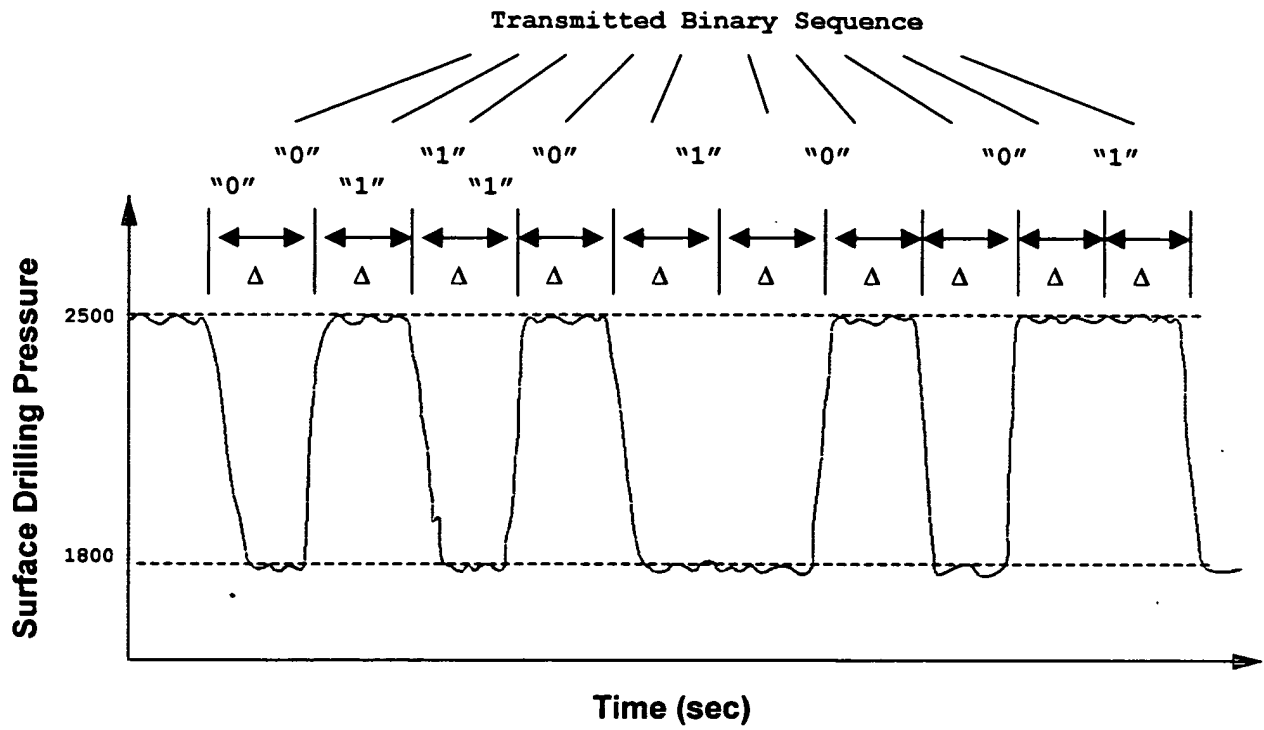


Figure 49 Binary Data Transmission Using Static Pump Pressure Levels

10035350-102601

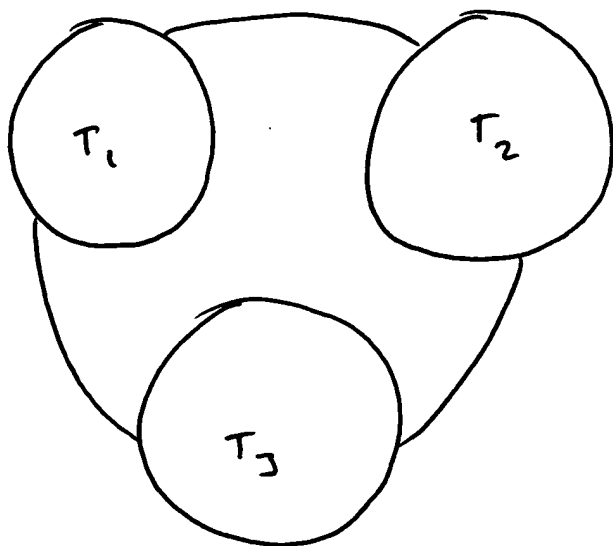


Figure 50

10035350-102601

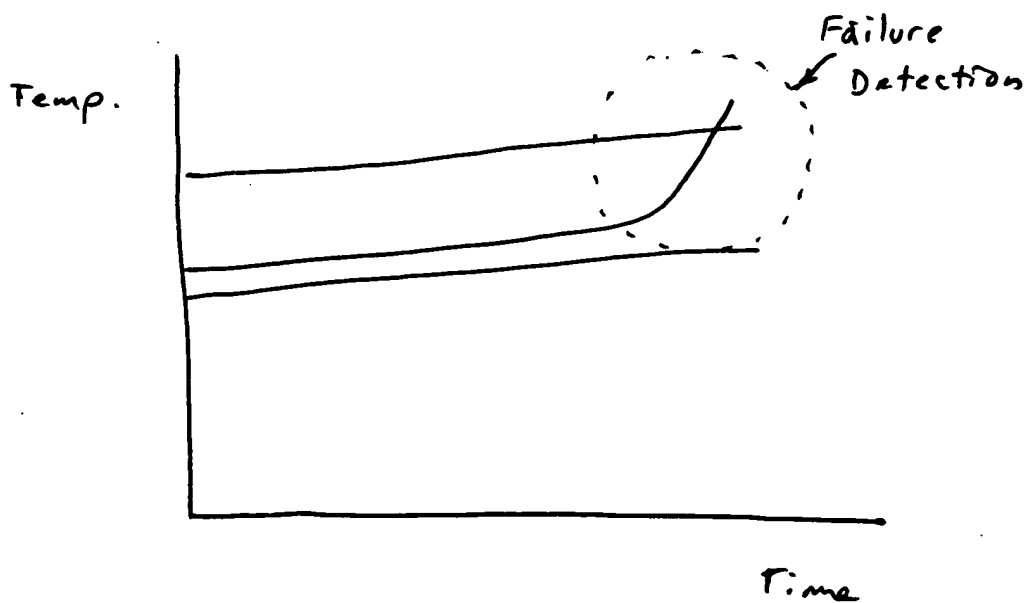


Figure 51

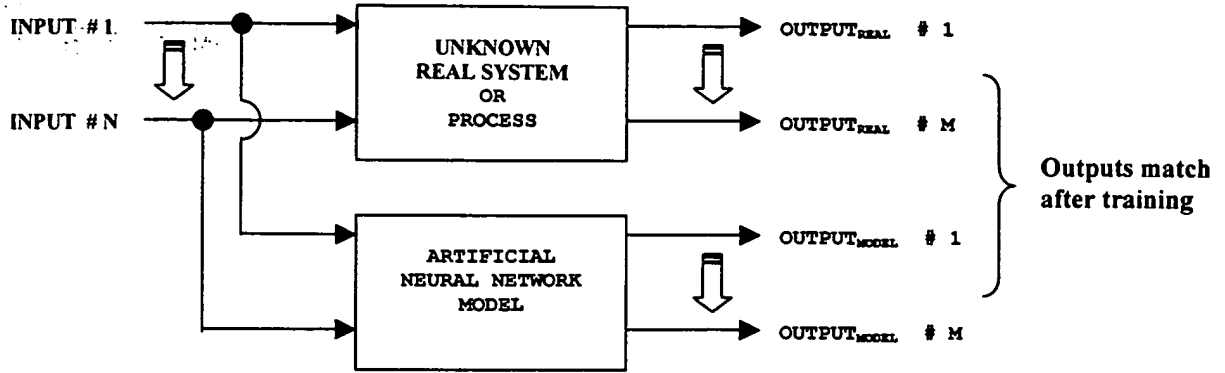


Figure 52 Neural Network Modeling
Real System

10035350-102601

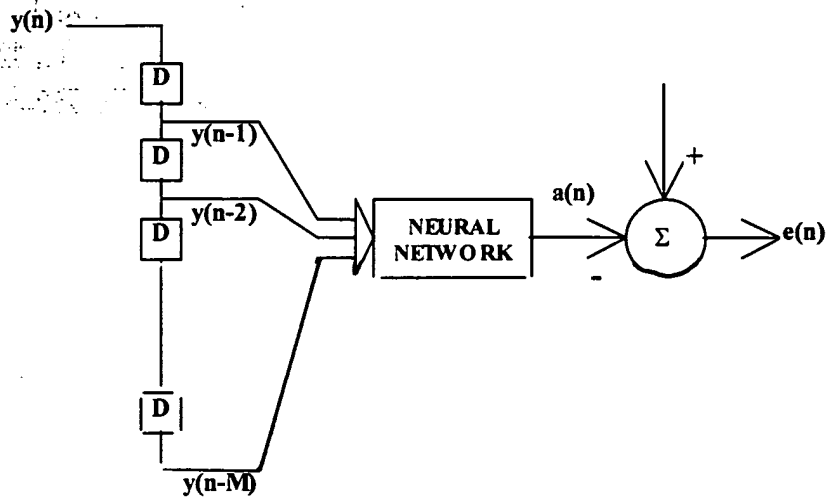


Figure 53

1003550-102601

10035350-102601

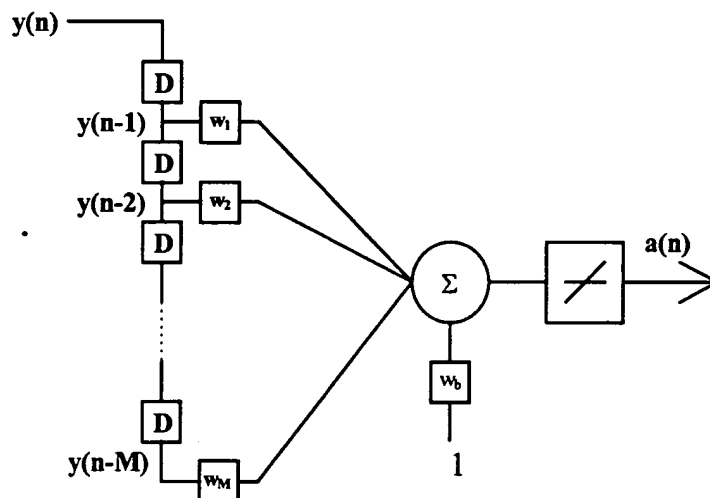


Figure 54 Basic Linear Network

10035350-103601

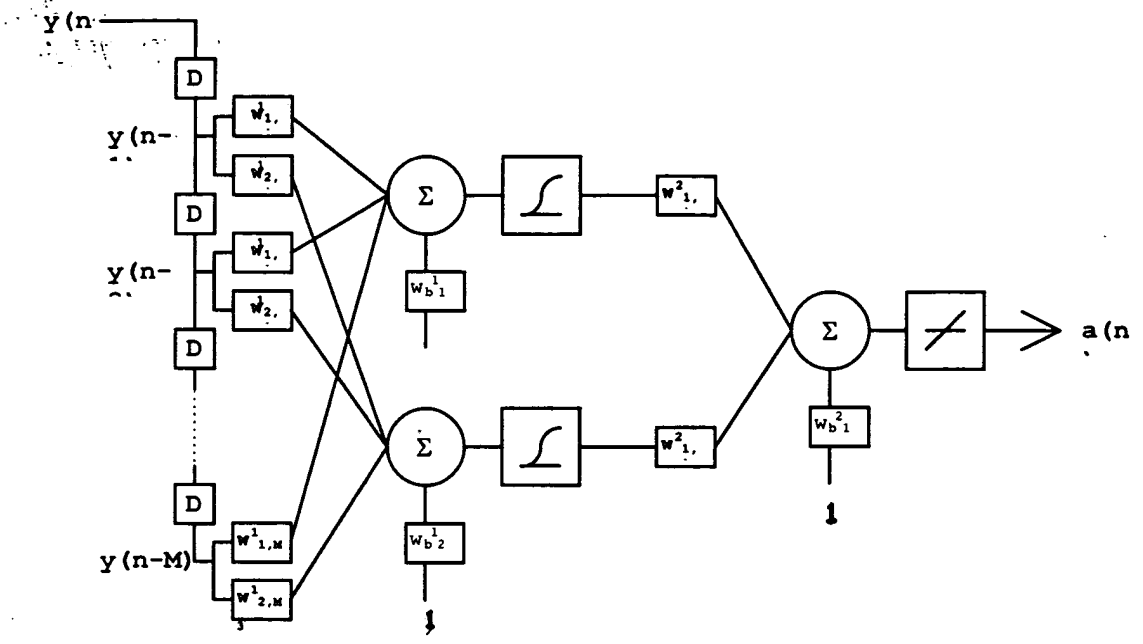


Figure 55

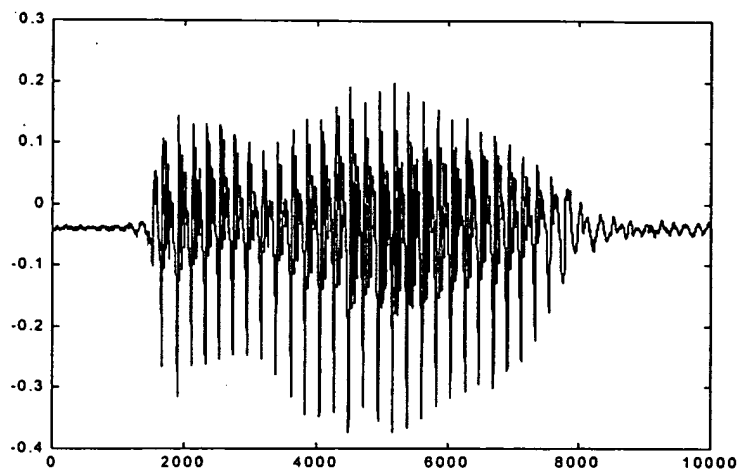
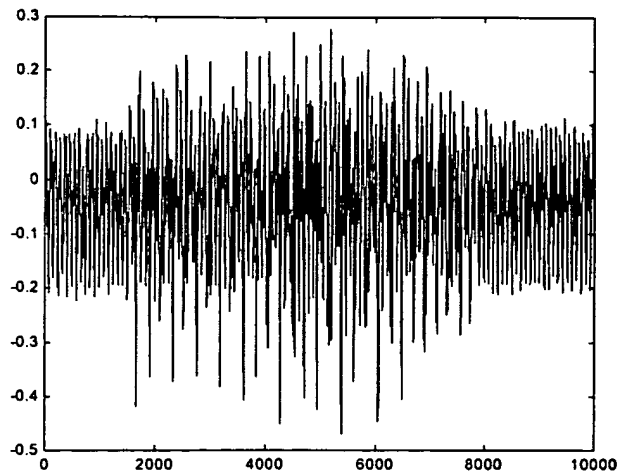
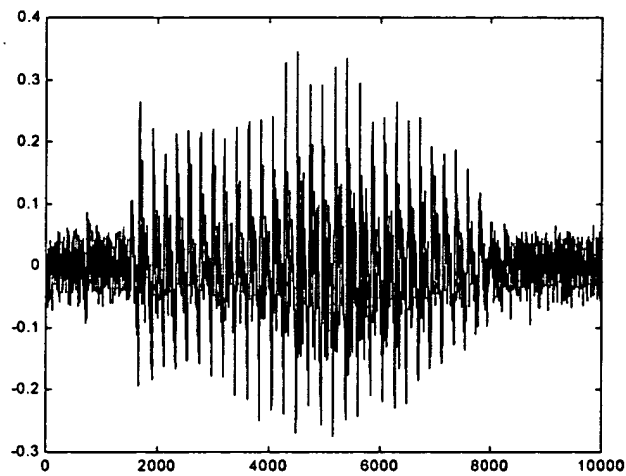


Figure 56

10035350-102601



Corrupt Signal S/N Ratio = .95

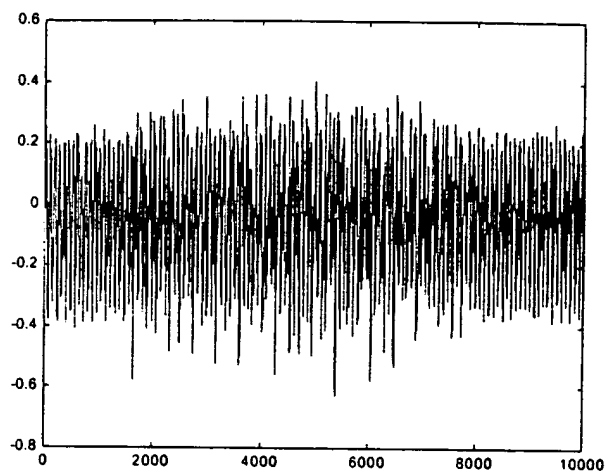


Filtered Signal S/N Ratio = 2.35

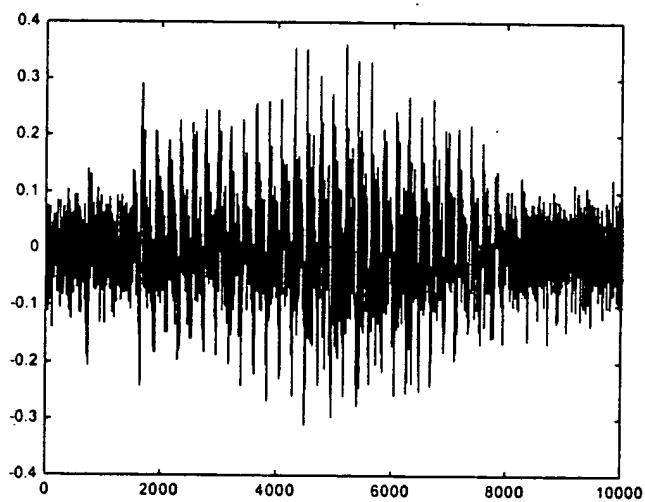
Figure 57

10035350-10601

10035350-102601



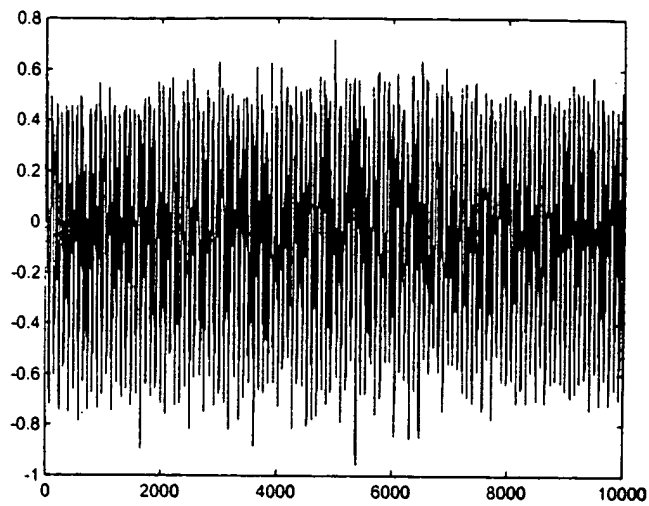
Corrupt Signal S/N Ratio = .24



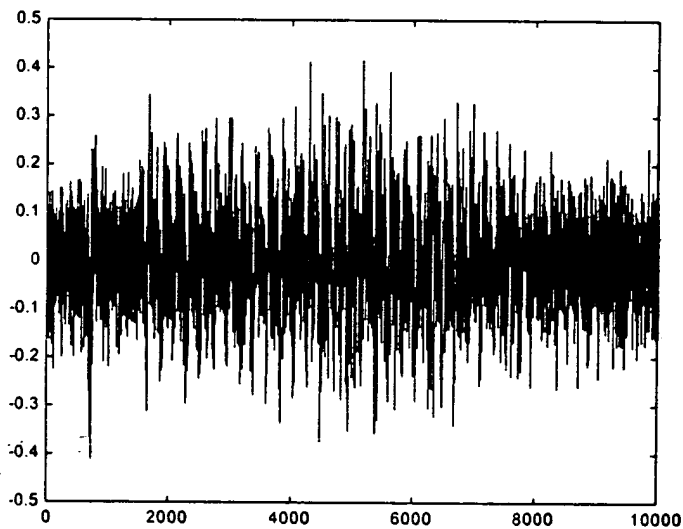
Filtered Signal S/N Ratio = 1.68

Figure 58

10035350-102601

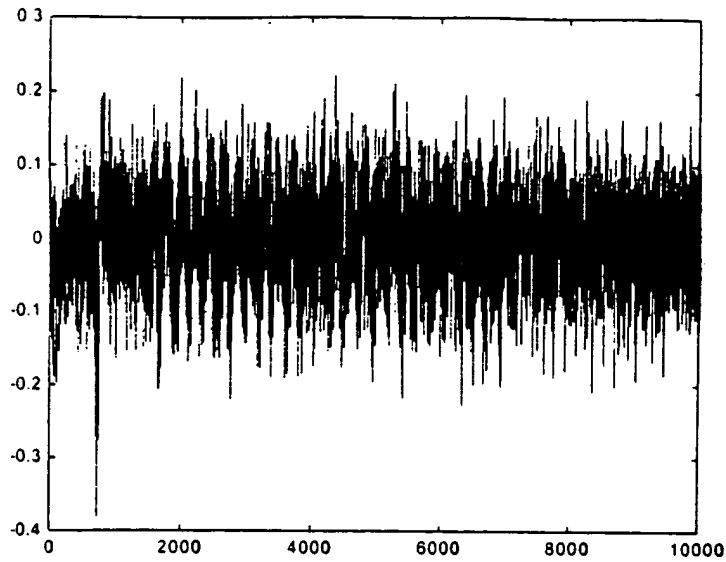


Corrupt Signal S/N Ratio = .06



Filtered Signal S/N Ratio = .89

Figure 59



Linear filter results. $S/N = .7457$

Figure 60

10035350-102601